REJ10J1680-0100

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R32C/100 E30A Emulator Debugger V.1.00 User's Manual

Renesas Microcomputer Development Environment System

User's Manual

Rev.1.00
July. 1, 2008

Renesas Technology
www.renesas.com

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Overview

The High-performance Embedded Workshop is a Graphical User Interface intended to ease the development and debugging of applications written in C/C++ programming language and assembly language for Renesas microcomputers. Its aim is to provide a powerful yet intuitive way of accessing, observing and modifying the debugging platform in which the application is running.

This help explains the function as a "debugger" of High-performance Embedded Workshop.

Target System

The Debugger operates on the emulator E30A system.

Supported CPU

This help explains the debugging function corresponding to the following CPUs.

- R32C/100 Series
  Note: In this help, the information which depends on this CPU is described as "for R32C".

For inquiries about the contents of this document or product, fill in the text file the installer generates in the following directory and email to your local distributor.

¥SUPPORT¥Product-name¥SUPPORT.TXT

Renesas Tools Homepage http://www.renesas.com/en/tools

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Setup of Debugger

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1. Features

1.1 RAM Monitor Function

This debugger supports the real time RAM monitor function which allows you to reference the memory data during execution of the target program.
The memory contents being displayed can be periodically updated.
However, the real time capability of program execution is lost.
To operate the RAM monitor function, set as follows.

- Set the RAM monitor event to the event E5 in the Event Setting window or the RAM monitor area setup window.
- Select the menu ([RAM Monitor]->[Enable RAM Monitor]) of each window which supports the RAM monitor function.

Specify the memory data acquisition interval time during executing the target program in the Emulator tab of the Init dialog.

1.1.1 RAM Monitor Area

This debugger has 1 Kbytes of RAM monitor area which can be located in any contiguous address location or in 64 separate blocks comprised of 16 bytes each.

1.1.2 Sampling Period

Sampling cycle means the display update interval.
You can specify this function in any window which supports the RAM monitor. (The interval of 1s is set by default.)
The actual sampling cycle may take longer time than the specified cycle depending on the operating environment.
(Sampling cycle depends on the following environments.)

- Communication interface
- Number of the RAM Monitor windows displayed
- Size of the RAM Monitor window displayed
- Number of ASM watch points within the RAM monitor area of the ASM Watch window
- Number of C watch points within the RAM monitor area of the C Watch window

1.1.3 Related Windows

The window where the function of the RAM monitor function can be used is shown below.

- RAM Monitor Window
- ASM Watch Window
- C Watch Window

1.2 Break Functions

1.2.1 Software Breaks Function

Software Break breaks the target program before execution of the command at the specified address. This break point is called software breakpoint.
The software breakpoint is set/reset in the Editor (Source) window or in the S/W Breakpoint Setting window. You can also disable/enable a software breakpoint temporarily.
You can specify up to 64 software breakpoints. When specifying two or more software breakpoints, the breakpoint combination is based on the OR logic. (Arrival to any one of breakpoints breaks the target program.)

1.2.1.1 Setting of software breakpoint

The software breakpoint can be set by the following windows.

- Editor (Source) Window
- S/W Break Point Setting Window

You can double-click the mouse to set/reset the software breakpoint in the Editor (Source) window.
You can also switch to temporarily disable/enable the software breakpoint in the S/W Breakpoint Setting window.

1.2.1.2 Area where software breakpoint can be set

The area which can be set for software breakpoint varies depending on the product.
For the areas available for software breakpoint, see the following:
"12.1.2 Area where software breakpoint can be set"

1.2.2 Hardware Break

This function causes the target program to stop upon detecting a data read/write to memory and instruction execution.
Event breaks come in two types of breaks as shown below.

- Instruction Execution Break
  The instruction execution break is used to detect instruction execution, and the target program is made to stop immediately before executing the instruction at a specified address.
- Memory Access Break
  A data write/read to or from memory is detected when a specified address is accessed for data, upon which the target program is made to stop (post-execution break).

A total of 8 events comprised of break events, trace events, and time measurement events in combination can be specified. Instruction execution allows you to specify the function name.
For the address designation method, memory access allow the range designation, in addition to the normal one-address designation. Moreover, memory access allows you to specify the comparison data to read/write data related to the specified address in the same manner as when setting the breakpoint. It also allows mask designation to the comparison data. Note, however, that comparison data can be specified for only one event. You cannot specify an address range.

Specified hardware break events can be used in one of the following combinations:

- Break when any one of the specified break points is effected. (Or)
- Events occur in a specified order. (Sequential)

1.3 Real-Time Trace Function

This function records a target program execution history.

Up to 8M cycles of execution history can be recorded. This record allows inspecting the bus information, executed instructions, and source program execution path for each cycle.

The real-time trace function records the execution history of the target program.

The execution history is referred to in the tracing window.

The execution history can be referred to in the following mode.

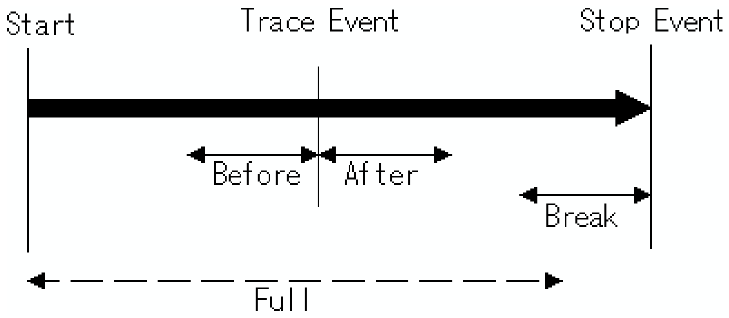
- BUS mode
  This mode allows you to inspect cycle-by-cycle bus information. The display content depends on the MCU and emulator system used. In addition to bus information, this mode allows disassemble, source line or data access information to be displayed in combination.
- Disassemble mode
  This mode allows you to inspect the executed instructions. In addition to disassemble information, this mode allows source line or data access information to be displayed in combination.
- Data access mode
  This mode allows you to inspect the data read/write cycles. In addition to data access information, this mode allows source line information to be displayed in combination.
- Source mode
  This mode allows you to inspect the program execution path in the source program.

1.3.1 Trace Area

The 8M cycles execution history can be referred to with this debugger.

The trace area of the following 4 mode is being supported.

- Break
  8M cycles before target program stops
- Before
  8M cycles before trace point
- After
  8M cycles after trace point
- Full
  Until 8M cycles are written in the trace memory



To perform a trace measurement, you need to set a trace range and a trace event.

By default, Break is set for the trace range, and an event for measuring jump address information in the entire address range is set as the trace event.

1.3.2 Trace Condition Setting

The following designations are available as trace events:

- Branch trace
- Data trace
- Condition branch trace

A mixed trace of branch and data traces can be performed.
A total of 8 events comprised of break events, trace events, and time measurement events in combination can be specified.
Trace events can be combined as below:

- Trace when one of the valid events is established (OR condition)

1.4 Time Measurement Function

Execution time measurement
This function measures all execution times.

Interval time measurement
This function measures the minimum, maximum, and average execution time and the number of executions performed in a specified interval.
Measurements can be taken in up to three intervals at the same time.

1.4.1 The Measurement Condition

Execution time measurement
Measuring the program execution time from when the program started to when it stops.

Interval time measurement
The measurement condition of the zone time can specify the following.

- Time between two events

1.5 Real-Time OS Debugging Function

This function debugs the realtime OS-dependent parts of the target program that uses the realtime OS.
This function helps to show the status of the realtime OS.

1.6 GUI Input/Output Function

This function simulates the user target system's key input panel (buttons) and output panel on a window.
Buttons can be used for the input panel, and labels (strings) and LEDs can be used for the output panel.

2. About the Emulator E30A

The E30AEmulator is an on-chip debugging emulator that makes use of the debugging circuit, or 1 Pin NSD (New Single-wire Debugger), that is built in the R32C/100 series MCUs.
1 Pin NSD is Renesas original OCD (On-chip Debugger).
Using only the BYTE pin of the target MCU as a communication path, it permits the MCU operation and electrical characteristics, etc. to be debugged under a condition close to that of the user's final product.

2.1 Communication method

The supported communication method is USB communication.

2.2 Function table

The supported functions are as follows.

Function	Emulator E30A
S/W Break	64 points
Event Break	8 points (A total of 8 events comprised of break events, trace events, and time measurement events in combination can be specified.)
Real-Time Trace	8M cycles
RAM monitor	1K bytes (16bytes x 64blocks) area
Time Measurement	Go to Stop / 3 points interval

3. Before starting the debugger

3.1 Communication method by emulator

The supported communication method is as follows.

- USB

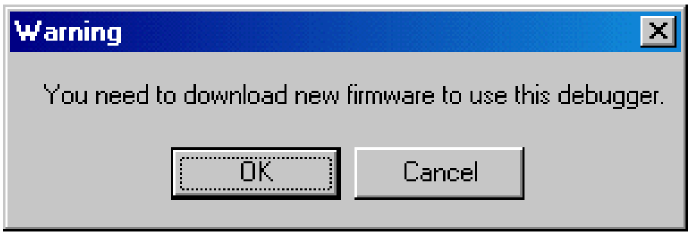
3.1.1 USB Interface

- Compliant with USB Standard 2.0.
- Connections via USB hub are not supported.
- The necessary cable is included with the emulator.

3.2 Download of Firmware

This debugger searches the version of the firmware downloaded to the emulator at start. Also when the firmware downloaded to the emulator is of old version, a mode which drives this debugger to download firmware is set.

When this debugger gets started while the emulator is set in the mode which drives the debugger to download firmware forcedly, the following dialog is opened at start.
Click the OK button to download the firmware.



Warning

You need to download new firmware to use this debugger.

3.3 Setting before emulator starts

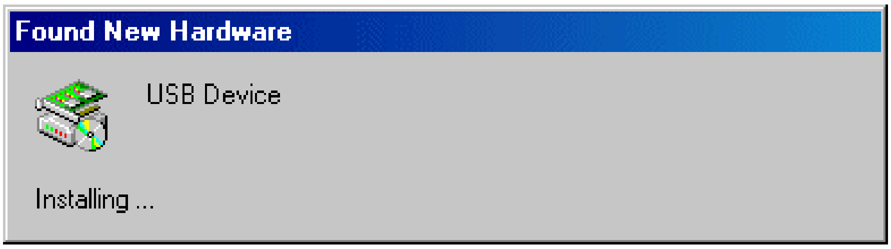
3.3.1 USB communication

Connection of USB devices is detected by Windows' Plug & Play function. The device driver needed for the connected USB device is automatically installed.

3.3.1.1 Install of USB device driver

The USB devices connected are detected by Windows' Plug & Play function. The installation wizard for USB device drivers starts after the device had been detected. The following shows the procedure for installing the USB device drivers.

1. Connect the host computer and the emulator with USB cable.
2. Then turn on the power to the emulator.
3. The dialog box shown below appears.



Found New Hardware

USB Device

Installing ...

Go on following the wizard, and a dialog box for specifying the setup information file (inf file) is displayed. Specify the e1usb.inf file stored in a location below the directory where this debugger is installed.

ATTENTION

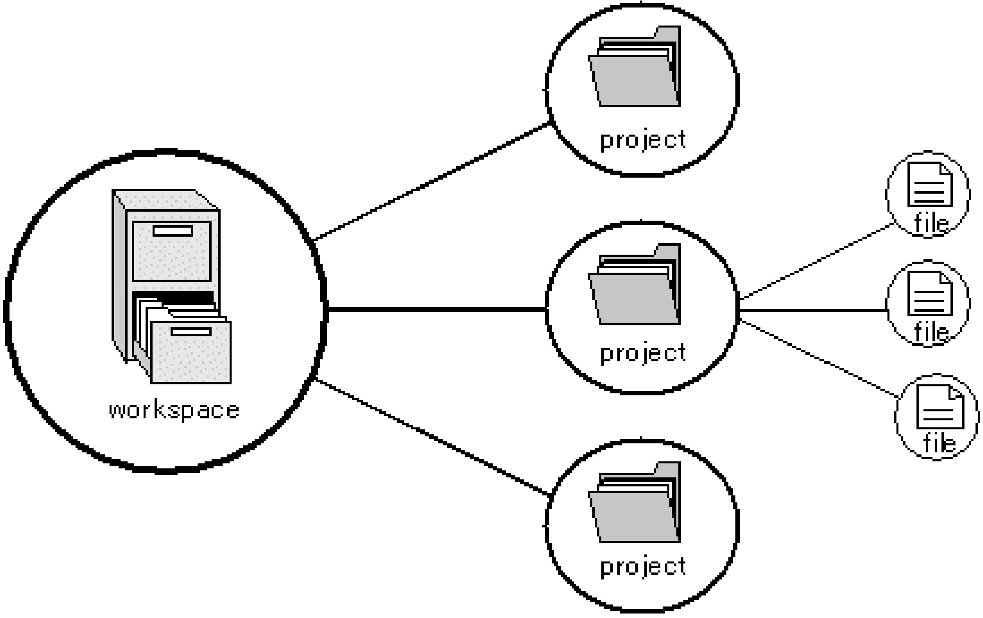
- Before the USB device drivers can be installed, the debugger you use must already be installed. Install this debugger first.
- A user who install the USB device driver need administrator rights.
- During installation, a message may be output indicating that the device driver proper e1usb.sys cannot be found. In this case, specify the e1usb.sys which is stored in the same directory as is the e1usb.inf file.

4. Preparation before Use

Please run the High-performance Embedded Workshop and connect the emulator .
In addition, in order to debug with this product, it is necessary to create a workspace.

4.1 Workspaces, Projects, and Files

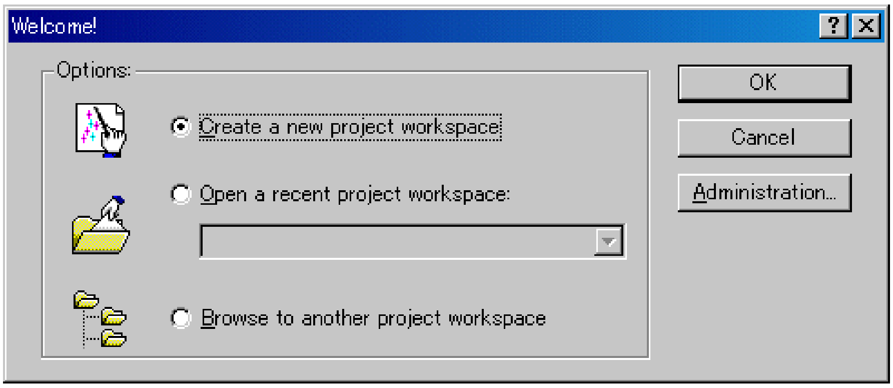
Just as a word processor allows you to create and modify documents, this product allows you to create and modify workspaces.
A workspace can be thought of as a container of projects and, similarly, a project can be thought of as a container of project files. Thus, each workspace contains one or more projects and each project contains one or more files.



Workspaces allow you to group related projects together. For example, you may have an application that needs to be built for different processors or you may be developing an application and library at the same time. Projects can also be linked hierarchically within a workspace, which means that when one project is built all of its "child" projects are built first.
However, workspaces on their own are not very useful, we need to add a project to a workspace and then add files to that project before we can actually do anything.

4.2 Starting the High-performance Embedded Workshop

Activate the High-performance Embedded Workshop from [Programs] in the [Start] menu.
The [Welcome!] dialog box is displayed.


Welcome!
Options:
● Create a new project workspace
○ Open a recent project workspace:
○ Browse to another project workspace
OK
Cancel
Administration...

In this dialog box, A workspace is created or displayed.

- [Create a new project workspace] radio button:
  Creates a new workspace.
- [Open a recent project workspace] radio button:
  Uses an existing workspace and displays the history of the opened workspace.
- [Browse to another project workspace] radio button:
  Uses an existing workspace;
  this radio button is used when the history of the opened workspace does not remain.

In the case of Selecting an Existing Workspace, select [Open a recent project workspace] or [Browse to another project workspace] radio button and select the workspace file (.hws).

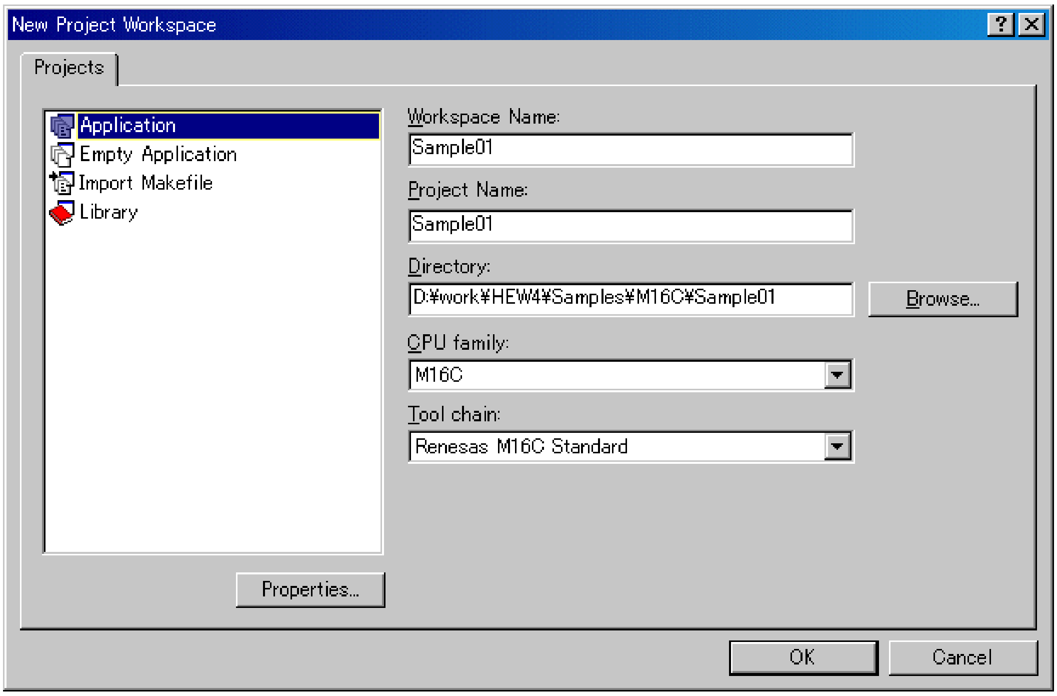
Please refer to the following about the method to create a new workspace.
Refer to "4.2.1 Creating a New Workspace (Toolchain Used)"
Refer to "4.2.2 Creating a New Workspace (Toolchain Not Used)"
* When debugging the existing load module file with this product, a workspace is created by this method.

The method to create a new workspace depends on whether a toolchain is or is not in use. Note that this product does not include a toolchain. Use of a toolchain is available in an environment where the C/C++ compiler package for the CPU which you are using has been installed.
For details on this, refer to the manual attached to your C/C++ compiler package.

4.2.1 Creating a New Workspace (Toolchain Used)

4.2.1.1 Step1 : Creation of a new workspace

In the [Welcome!] dialog box that is displayed when the High-performance Embedded Workshop is activated, select the [Create a new project workspace] radio button and click the [OK] button.
Creation of a new workspace is started.
The following dialog box is displayed.



Workspace Name: Sample01

Project Name: Sample01

Directory: D:¥work¥HEW4¥Samples¥M16C¥Sample01

CPU family: M16C

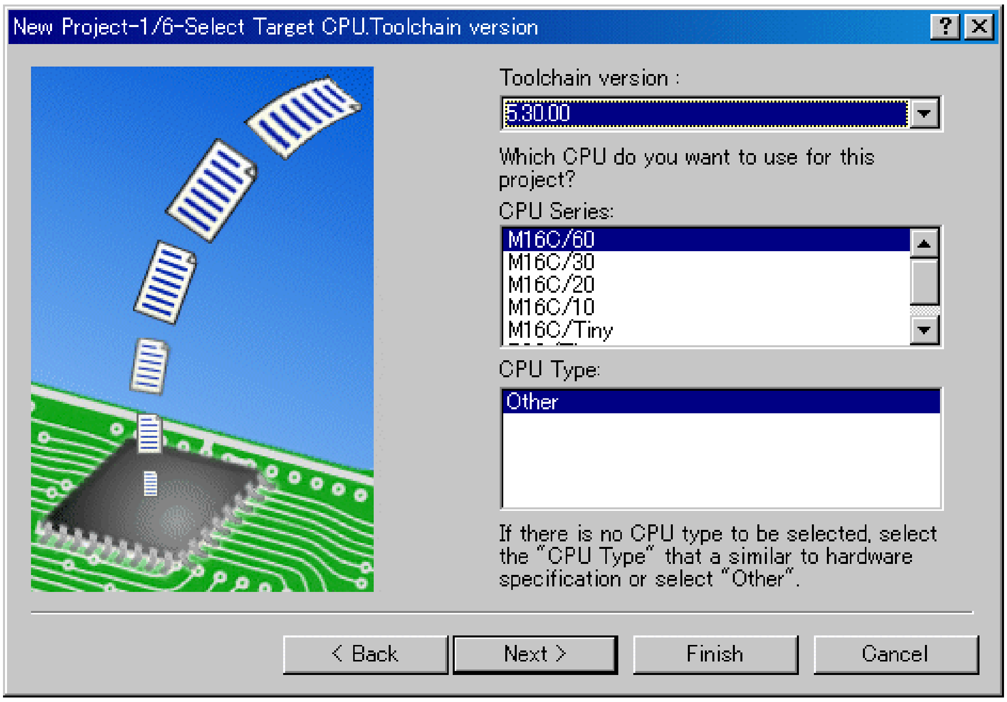
Tool chain: Renesas M16C Standard

1. Select the target CPU family
   In the [CPU family] combo box, select the target CPU family.
2. Select the target toolchain
   In the [Tool chain] combo box, select the target toolchain name when using the toolchain.
3. Select the project type
   In the [Project type] list box, select the project type to be used.
   In this case, select "Application" .
   (Please refer to the manual attached to your C/C++ compiler package about the details of the project type which can be chosen.)
4. Specify the workspace name and project name
   - In the [Workspace Name] edit box, enter the new workspace name.
   - In the [Project Name] edit box, enter the project name. When the project name is the same as the workspace name, it needs not be entered.
   - In the [Directory] edit box, enter the directory name in which the workspace will be created. Click the [Browse...] button to select a directory.

After a setting, click the [OK] button.

4.2.1.2 Step2 : Setting for the Toolchain

A wizard for the project creation starts.



New Project-1/6-Select Target CPU.Toolchain version

Toolchain version : 5.30.00

Which CPU do you want to use for this project?

CPU Series: M16C/60, M16C/30, M16C/20, M16C/10, M16C/Tiny

CPU Type: Other

If there is no CPU type to be selected, select the "CPU Type" that a similar to hardware specification or select "Other".

Here, the following contents are set.

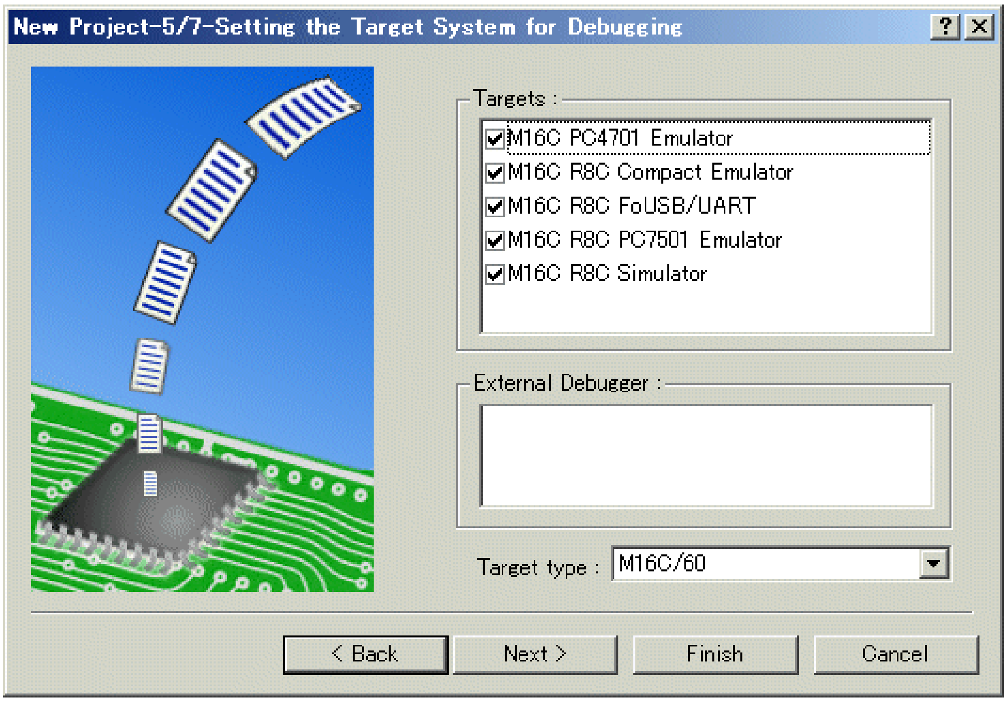
- toolchain
- the setting for the real-time OS (when using)
- the setting for the startup file, heap area, stack area, and so on

Please set required information and click the [Next] button.

The contents of a setting change with C/C++ compiler packages of use. Please refer to the manual attached to your C/C++ compiler package about the details of the contents of a setting.

4.2.1.3 Step 3: Selecting of the Target Platform

Select the target system used for your debugging (emulator, simulator).
When the setting for the toolchain has been completed, the following dialog box is displayed.



New Project-5/7-Setting the Target System for Debugging

Targets :

☑ M16C PC4701 Emulator
☑ M16C R8C Compact Emulator
☑ M16C R8C FoUSB/UART
☑ M16C R8C PC7501 Emulator
☑ M16C R8C Simulator

External Debugger :

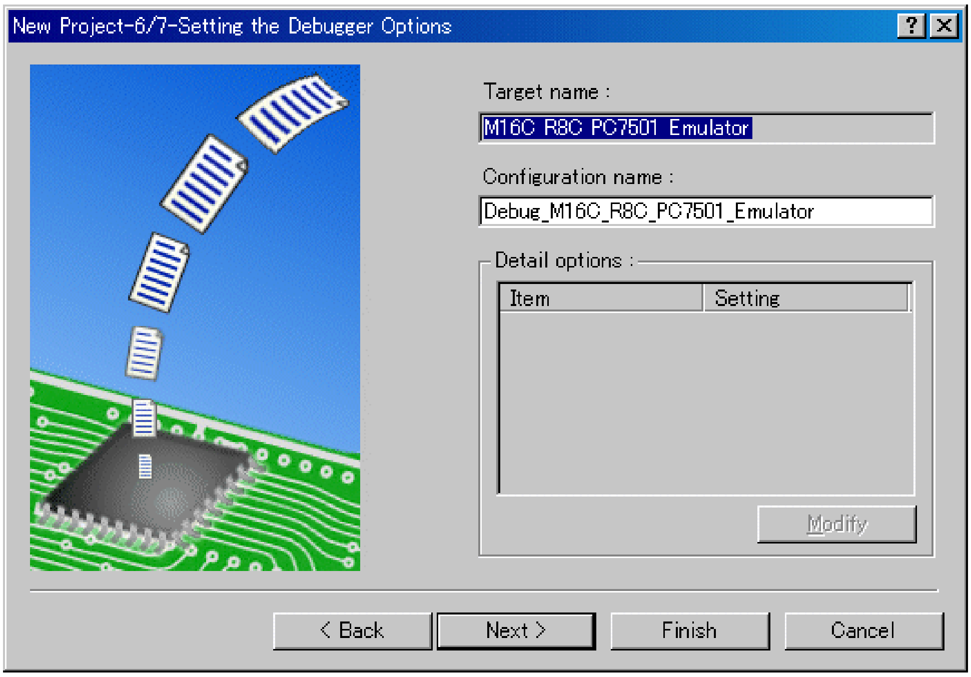
Target type : M16C/60

1. Selecting of the Target type
   In the [Target type] list box, select the target CPU type.
2. Selecting of the Target Platform
   In the [Targets] area, the target for the session file used when this debugger is activated must be selected here. Check the box against the target platform. (And choose other target as required.)

And click the [Next] button.

4.2.1.4 Step4 : Setting the Configuration File Name

Set the configuration file name for each of the all selected target.
The configuration file saves the state of High-performance Embedded Workshop except for the target (emulator, simulator).



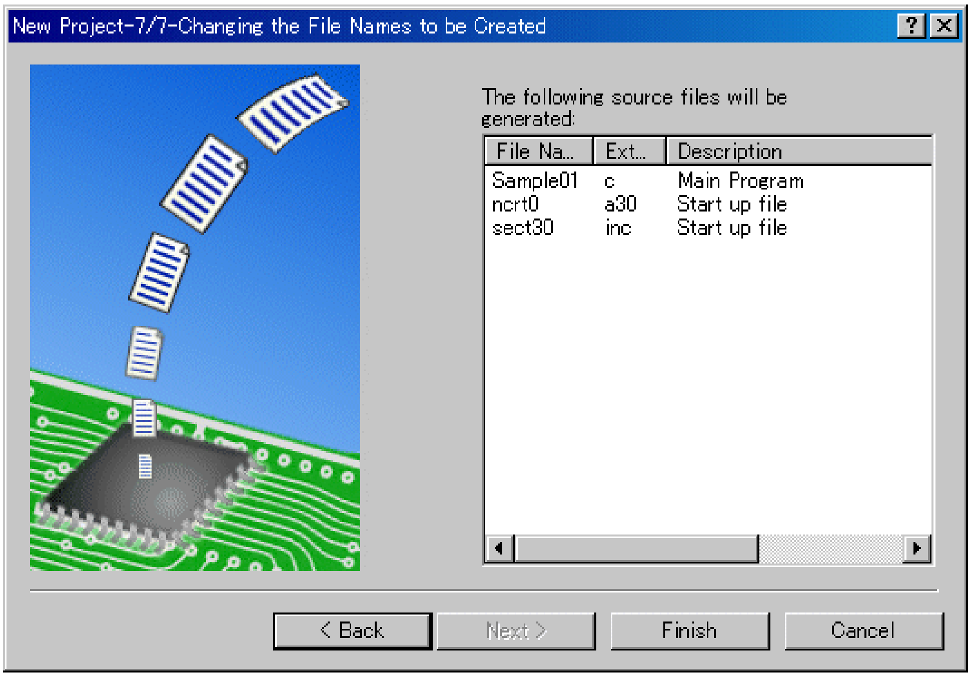
Target name :
M16C R8C PC7501 Emulator

Configuration name :
Debug_M16C_R8C_PC7501_Emulator

The default name is already set. If it is not necessary to change, please click the [next] button as it is.

4.2.1.5 Step5 : The check of a created file name

Finally, confirm the file name you create. The files which will be generated by the High-performance Embedded Workshop are displayed If you want to change the file name, select and click it then enter the new name.



New Project-7/7-Changing the File Names to be Created

The following source files will be generated:

File Na...	Ext...	Description
Sample01	c	Main Program
ncrt0	a30	Start up file
sect30	inc	Start up file

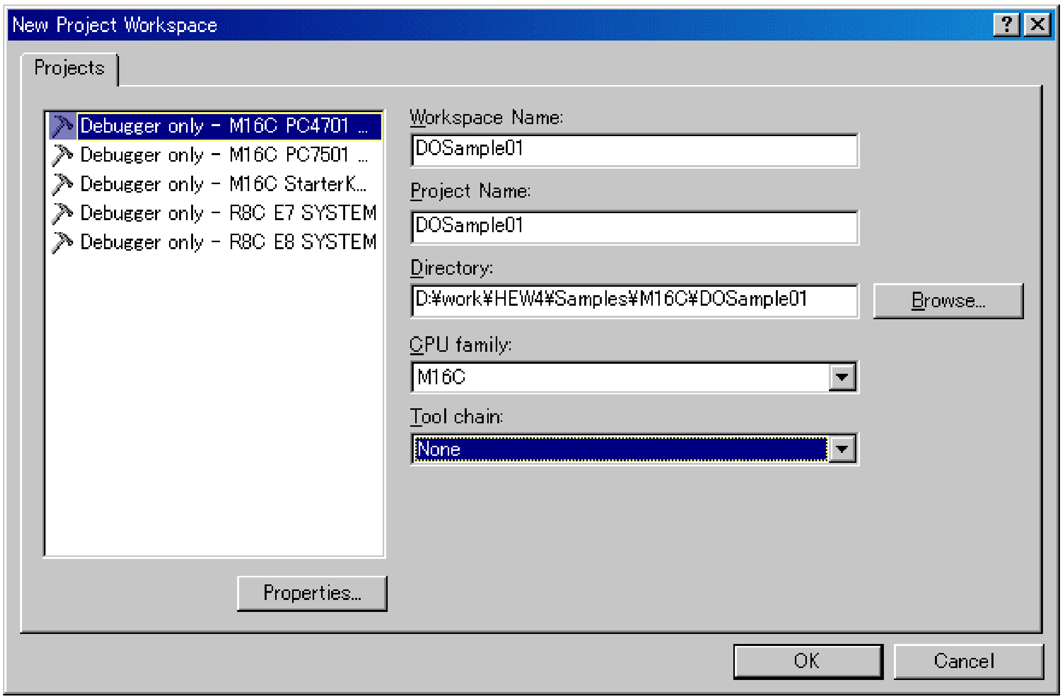
This is the end of the emulator settings.
Exit the Project Generator following the instructions on the screen.

4.2.2 Creating a New Workspace (Toolchain Not Used)

When debugging the existing load module file with this product, a workspace is created by this method. (It can work even if the tool chain is not installed.)

4.2.2.1 Step1 : Creation of a new workspace

In the [Welcome!] dialog box that is displayed when the High-performance Embedded Workshop is activated, select the [Create a new project workspace] radio button and click the [OK] button.
Creation of a new workspace is started. The following dialog box is displayed.



New Project Workspace

Workspace Name: DOSample01

Project Name: DOSample01

Directory: D:¥work¥HEW4¥Samples¥M16C¥DOSample01

CPU family: M16C

Tool chain: None

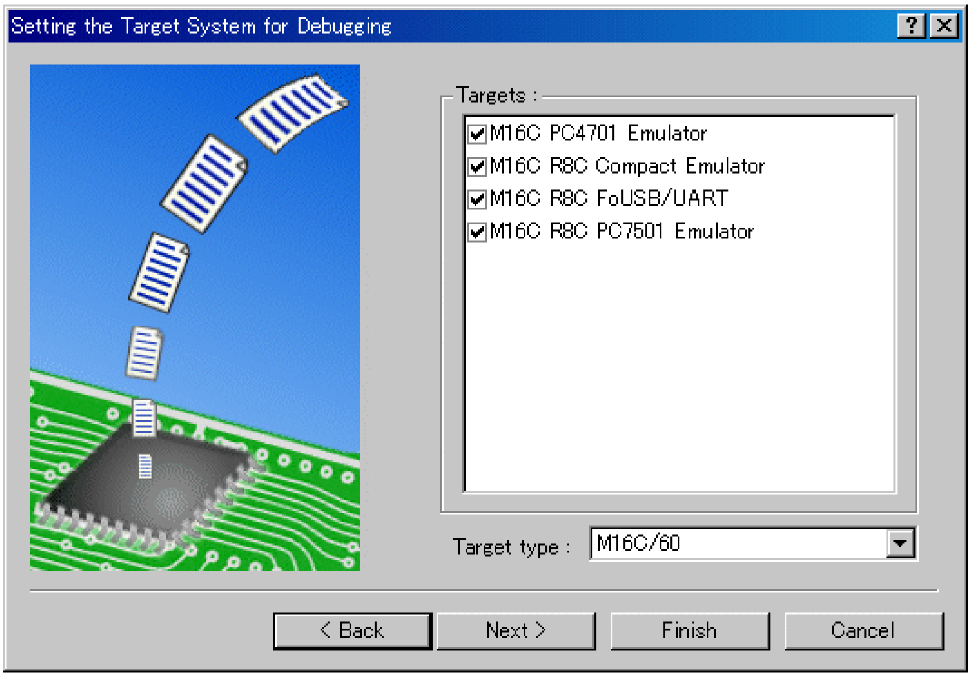
Projects
Debugger only - M16C PC4701 ...
Debugger only - M16C PC7501 ...
Debugger only - M16C StarterK...
Debugger only - R8C E7 SYSTEM
Debugger only - R8C E8 SYSTEM
Browse...
Properties...
OK
Cancel

1. Select the target CPU family
   In the [CPU family] combo box, select the target CPU family.
2. Select the target toolchain
   In the [Tool chain] combo box, select "None". In this case, toolchain is not used.
   (When the toolchain has not been installed, the fixed information is displayed in this combo box.)
3. Select the project type
   (When the toolchain is not used, it is displayed on a [Project Type] list box as "Debugger only - Target Name". Select it. (When two or more project types are displayed, please select one of them.)
4. Specify the workspace name and project name
   - In the [Workspace Name] edit box, enter the new workspace name.
   - In the [Project Name] edit box, enter the project name. When the project name is the same as the workspace name, it needs not be entered.
   - In the [Directory] edit box, enter the directory name in which the workspace will be created. Click the [Browse...] button to select a directory.

After a setting, click the [OK] button.

4.2.2.2 Step 2: Selecting of the Target Platform

Select the target system used for your debugging (emulator, simulator).
A wizard starts and the following dialog box is displayed.



Setting the Target System for Debugging

Targets :

☑ M16C PC4701 Emulator
☑ M16C R8C Compact Emulator
☑ M16C R8C FoUSB/UART
☑ M16C R8C PC7501 Emulator

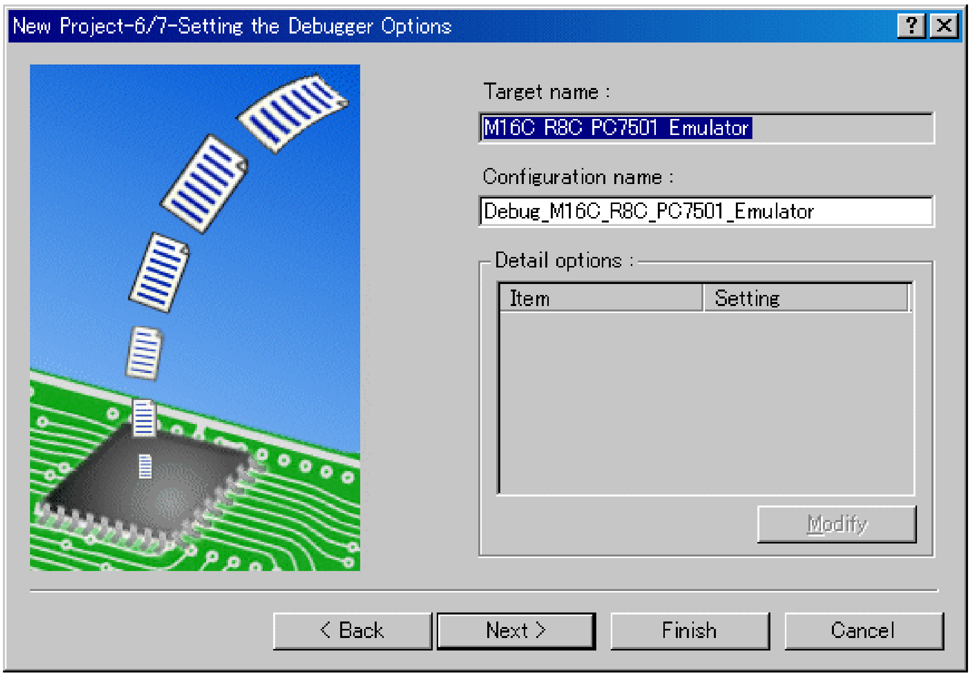
Target type : M16C/60

1. Selecting of the Target type
   In the [Target type] list box, select the target CPU type.
2. Selecting of the Target Platform
   In the [Targets] area, the target for the session file used when this debugger is activated must be selected here. Check the box against the target platform. (And choose other target as required.)

And click the [Next] button.

4.2.2.3 Step3 : Setting the Configuration File Name

Set the configuration file name for each of the all selected target.
The configuration file saves the state of High-performance Embedded Workshop except for the target (emulator, simulator).



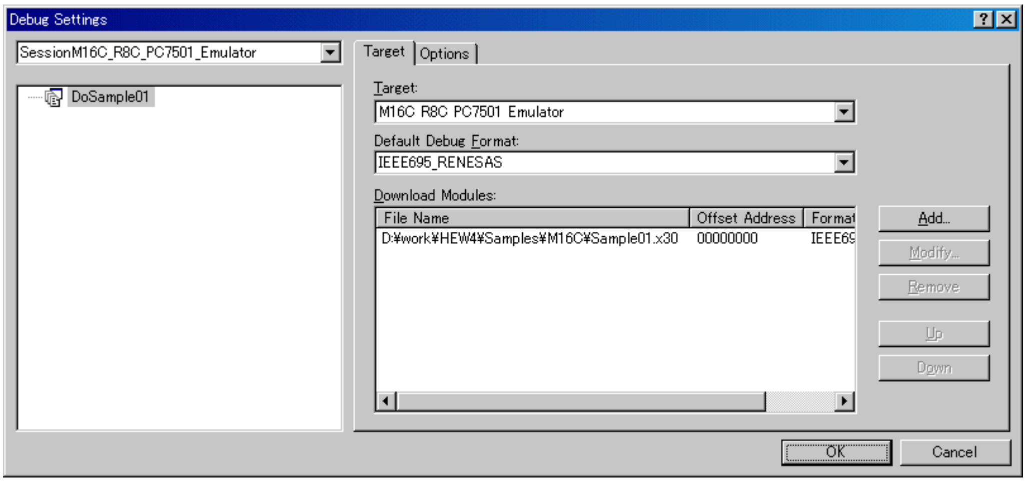
Target name :
M16C R8C PC7501 Emulator

Configuration name :
Debug_M16C_R8C_PC7501_Emulator

The default name is already set. If it is not necessary to change, please click the [next] button as it is.
This is the end of the emulator settings.
Exit the Project Generator following the instructions on the screen.
And the dialog for the setup of a debugger is also displayed at this time . If preparation of an emulator is completed, set up the debugger in this dialog box and connect with an emulator.

4.2.2.4 Step4 : Registering the Load modules to be downloaded

Finally, register the load module file to be used.
Select [Debug Settings...] from the [Debug] menu to open the [Debug Settings] dialog box.



Target: M16C R8C PC7501 Emulator

Default Debug Format: IEEE695_RENESAS

Download Modules:

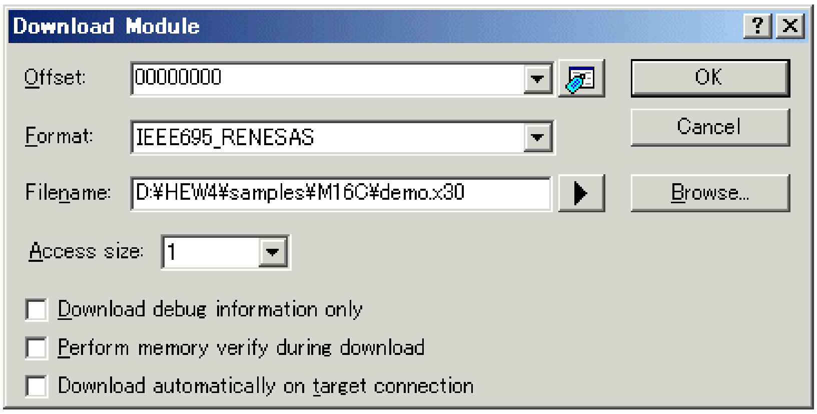
File Name	Offset Address	Format
D:¥work¥HEW4¥Samples¥M16C¥Sample01.x30	00000000	IEEE69

1. Select the product name to be connected in the [Target] drop-down list box.
2. Select the format of the load module to be downloaded in the [Default Debug Format] drop-down list box.

Format Name	Contents
IEEE695_RENESAS	IEEE-695 format file (When Using Renesas toolchain)
IEEE695_IAR	IEEE-695 format file (When Using IAR toolchain)
IEEE695_TASKING	IEEE-695 format file (When Using Tasking toolchain)
ELF/DWARF2	ELF/DWARF2 format file (When Using Renesas toolchain)
ELF/DWARF2_IAR	ELF/DWARF2 format file (When Using IAR toolchain)
ELF/DWARF2_TASKING	ELF/DWARF2 format file (When Using Tasking toolchain)
ELF/DWARF2_KPIT	ELF/DWARF2 format file (When Using KPIT toolchain)

This debugger does not support the object formats, which are not shown in the drop down list.

3. Then register the corresponding download module in the [Download Modules] list box.
   A download module can be specified in the dialog opened with a [Add...] button.



Download Module

Offset: 00000000

Format: IEEE695_RENESAS

Filename: D:¥HEW4¥samples¥M16C¥demo.x30

Access size: 1

☐ Download debug information only

☐ Perform memory verify during download

☐ Download automatically on target connection

- Select the format of the download module in the [Format] edit box. Please refer to the upper table about the format name of a download module.
- Enter the full path and filename of the download module in the [Filename] edit box.
- Specifies the access size for the current download module in the [Access size] list box.

After that, click the [OK] button.

ATTENTION

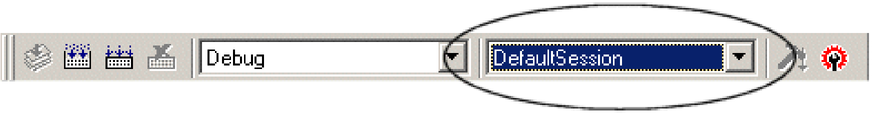
"Offset", "Access size" and "Perform memory verify during download" is ignored. The offset is always set to 0, the access size is always set to 1 and the verification does not work.

4.3 Starting the Debugger

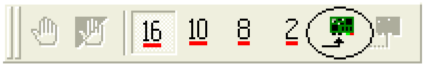
The debugging can be started by connecting with an emulator.

4.3.1 Connecting the Emulator

Connect the emulator by simply switching the session file to one in which the setting for the emulator use has been registered.
The session file is created by default. The session file has information about the target selected when a project was created.
In the circled list box in the following tool bars, select the session name including the character string of the target to connect.



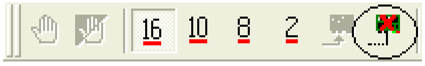
After the session name is selected, the dialog box for setting the debugger is displayed and the emulator will be connected.
When the dialog box is not displayed, select [Connect] from the [Debug] menu.



4.3.2 Ending the Emulator

The emulator can be exited by using the following methods:

1. Selecting the “Disconnect”
   Select [Disconnect] from the [Debug] menu.



2. Selecting the "DefaultSession"
   Select the "DefaultSession" in the list box that was used at the time of emulator connection.

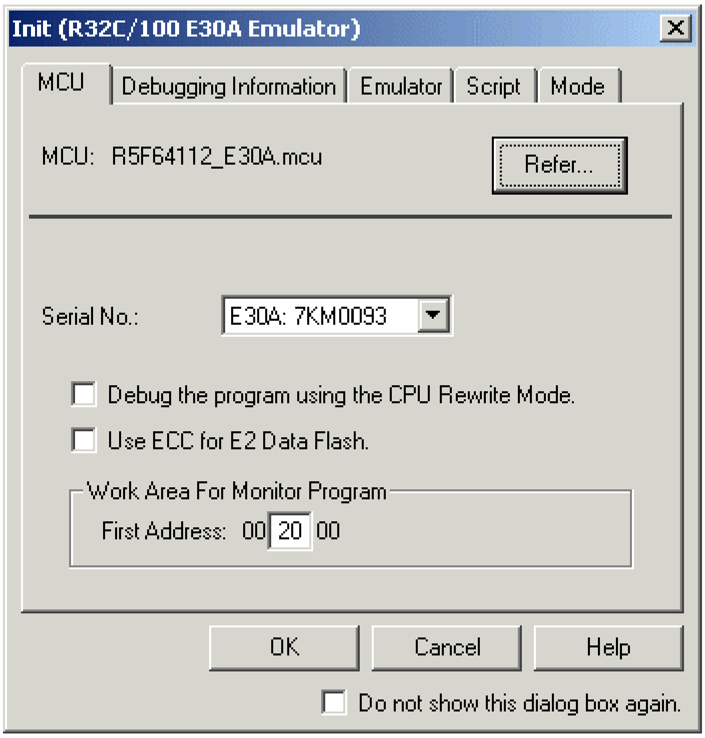
3. Exiting the High-performance Embedded Workshop
   Select [Exit] from the [File] menu. High-performance Embedded Workshop will be ended.

The message box, that asks whether to save a session, will be displayed when an emulator is exited. If necessary to save it, click the [Yes] button. If not necessary, click the [No] button.

5. Setup the Debugger

5.1 Init Dialog

The Init dialog box is provided for setting the items that need to be set when the debugger starts up. The contents set from this dialog box are also effective the next time the debugger starts. The data set in this dialog remains effective for the next start.



MCU: R5F64112_E30A.mcu

Serial No.: E30A: 7KM0093

□ Debug the program using the CPU Rewrite Mode.

□ Use ECC for E2 Data Flash.

Work Area For Monitor Program

First Address: 00 20 00

□ Do not show this dialog box again.

The tabs available on this dialog box vary with each product used. For details, click the desired tab name shown in the table below.

Tab Name	Product Name
	The debugger for R32C
MCU	exist
Debugging Information	exist
Emulator	exist
Script	exist
Debugging Mode	exist

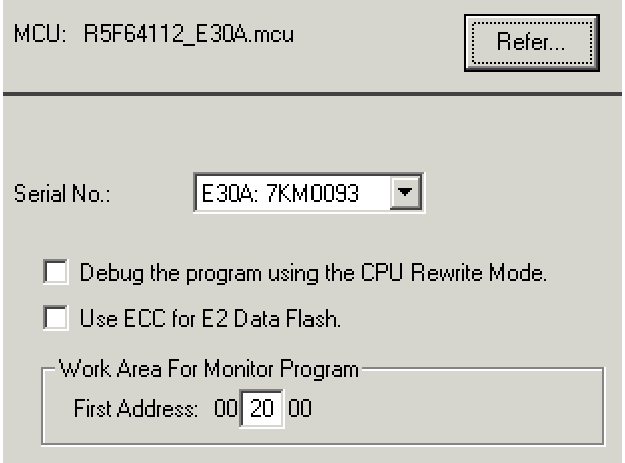
You can open the Init dialog using either one of the following methods:

- After the debugger gets started, select Menu - [Setup] -> [Emulator] -> [System...].

- Start Debugger while holding down the Ctrl key.

5.1.1 MCU Tab

The specified content becomes effective when the next being start.



MCU: R5F64112_E30A.mcu

Serial No.: E30A: 7KM0093

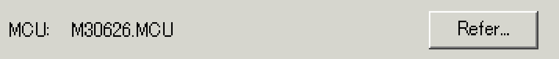
□ Debug the program using the CPU Rewrite Mode.

□ Use ECC for E2 Data Flash.

Work Area For Monitor Program

First Address: 00 20 00

5.1.1.1 Specifying the MCU file



MCU: M30626.MCU

Click the "Refer" button.
The File Selection dialog is opened. Specify the corresponding MCU file.

- An MCU file contains the information specific to the target MCU.
- The specified MCU file is displayed in the MCU area of the MCU tab.

5.1.1.2 Setting of the Communication Interface

The displayed data varies depending on the specified communication interface.
The available communication interface varies depending on the products.
The following shows the setting for each communication interface.

- Refer to "5.2.1 Setting of the USB Interface"

5.1.1.3 Choosing to use or not to use CPU rewrite mode

Specify whether or not you want to use CPU rewrite mode. (By default, CPU rewrite mode is unused.)

□ Debug the program using the CPU Rewrite Mode.

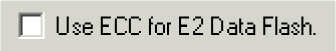
Select the above check box when you are debugging the target system that uses CPU rewrite mode.
This specification can only be set or changed when you start the debugger.

Supplementary explanation
When debugging in CPU rewrite mode is enabled, the following limitations apply:

- No software breaks can be set in the internal ROM area.

5.1.1.4 Choosing to use or not to use ECC in the E2 Data Flash

Specify whether or not you want to use ECC in the E2 Data Flash. (By default, ECC is unused.)

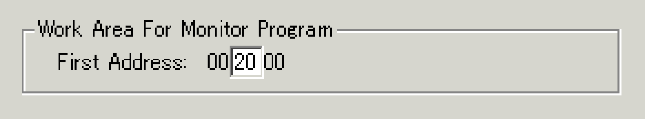


□ Use ECC for E2 Data Flash.

Select the above check box when you use ECC in the E2 Data Flash.
This specification can only be set or changed when you start the debugger.
This setting is invalid for MCU that doesn't support the E2 Data Flash.

5.1.1.5 Specifying the Start Address of the Debug Monitor Program

Specify the start address of the area (MCU's internal RAM area) to be used by the debug monitor program.



Work Area For Monitor Program

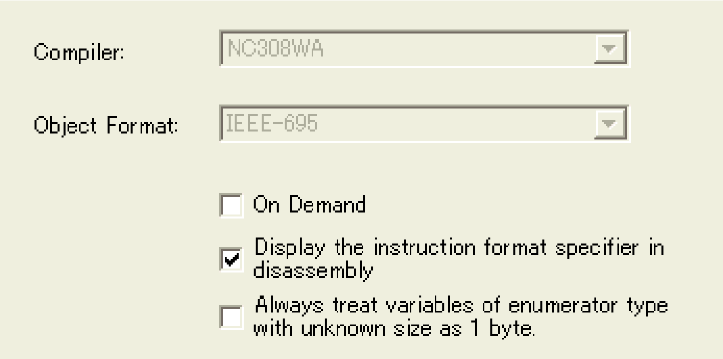
First Address: 00 20 00

The debug monitor program will use approximately 1K bytes of area beginning with the specified start address. Although no particular considerations need to be taken for it because the memory contents are saved in advance, the following precautions should be observed.

- Only the start address consisting of 00xx00 (xx = arbitrary) can be set. By default, the address 002000 is set.
- No areas that overlap the stack or the target area of DMA can be specified.

5.1.2 Debugging Information Tab

The specified content becomes effective when the next being start.



Compiler: NC308WA

Object Format: IEEE-695

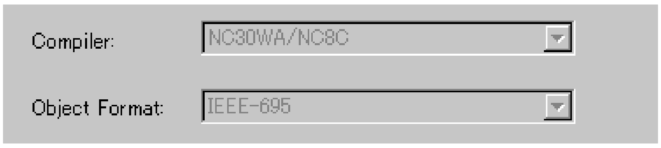
□ On Demand

☑ Display the instruction format specifier in disassembly

□ Always treat variables of enumerator type with unknown size as 1 byte.

5.1.2.1 display the compiler used and its object format

Display the compiler used and its object file format.



Compiler: NC30WA/NC8C

Object Format: IEEE-695

Please specify the compiler used and its object file format in the dialog opened by menu [Debug] -> [Debug Settings...].

5.1.2.2 Specify the Storing of Debugging Information

There are two methods for storing debugging information: on-memory and on-demand.
Select one of these two methods. (The on-memory method is selected by default.)
To select the on-demand method, click the On Demand check box.
The specified content becomes effective when the next being download.

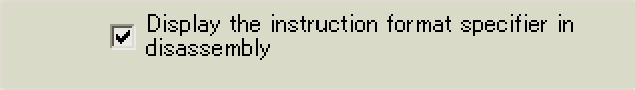
- On-memory method
  Debugging information is stored in the internal memory of your computer.
  Usually, select this method.
- On-demand method
  Debugging information is stored in a reusable temporary file on the hard disk of your computer.
  Because the stored debugging information is reused, the next time you download the same load module it can be downloaded faster.
  This method is suitable when it takes so long time to download the debugging information, because the PC has less memory against the load module file size.

Notes

- If the load module size is large, the on-memory method may be inefficient because it requires a very large amount of time for downloading. In such a case, select the on-demand method.
- In the on-demand method, a folder in which to store a reusable temporary file is created in the folder that contains the downloaded load module. This folder is named after the load module name by the word "~INDEX_" to it. If the load module name is "sample.abs", for example, the folder name is "~INDEX_sample". This folder is not deleted even after quitting the debugger.

5.1.2.3 Specify whether to display the instruction format specifier

Specify whether to display the instruction format specifier in the disassembled display.

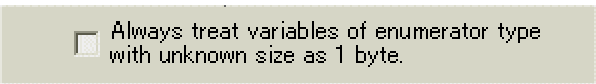


☑ Display the instruction format specifier in disassembly

Select the above check box when you display the instruction format specifier.
This specification can only be set or changed when you start the debugger.

5.1.2.4 To treat size of enumeration type as 1 byte

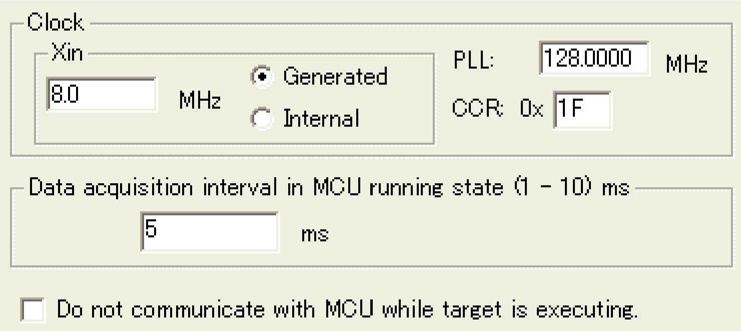
You can specify whether your debugger treat all sizes of enumeration types whose size is unknown in the debugging information as 1 byte. For reducing memory consumption, NC30, NC308 and NC100 have an option to treat the sizes of enumerator types as 1 byte and not as same size of 'int'. Note that NC30, NC308 and NC100 don't output the sizes of enumerator types in debugging information and debuggers consider the size as same size of 'int'. Therefore you may not correctly refer the values of enumeration types in the target programs which were compiled with the above option. This function is for resolving the above issue. See the users' manual of each compiler for details of the above option



□ Always treat variables of enumerator type with unknown size as 1 byte.

Check the above check box if you would like to treat all sizes of enumeration types as 1 byte. It is necessary to load the debugging information again in order to reflect this setting.

5.1.3 Emulator Tab



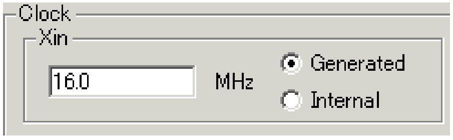
Clock
Xin
8.0 MHz
● Generated
○ Internal
PLL: 128.0000 MHz
CCR: 0x 1F

Data acquisition interval in MCU running state (1 - 10) ms
5 ms

□ Do not communicate with MCU while target is executing.

5.1.3.1 Specify the Target Clock

Change the setting by synchronizing with the clock used by the target microcomputer. (Generated is set by default.)



Clock
Xin
16.0 MHz
● Generated
○ Internal

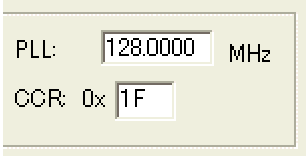
Select the option "Generated" if the frequency you have set should be set for the clock internally generated by the emulator (user-defined clock), or select "Internal" if said frequency should be set for the internal clock.

No matter whether you set the user-defined clock or the internal clock, be sure to enter the frequency to be used in the frequency input text box. (By default, no values are set.)

- The user-defined clock in the debugger can be input in the range 1.0000 MHz to 99.9999 MHz* in 0.0001 MHz increments.
- The value in the frequency input text box can only be set or altered at debugger startup.
- The debugger cannot be started unless any value is set in the frequency input text box.

5.1.3.2 Setting of PLL circuit

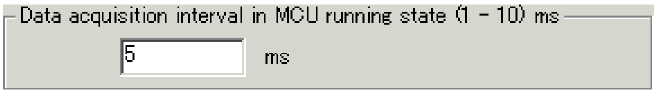
Enter the frequency of the internal PLL of the target MCU.
Enter the value of the internal clock control register of the target MCU.



PLL: 128.0000 MHz
CCR: 0x 1F

5.1.3.3 Specifying Memory Data Acquisition Intervals during Target Program Execution

While the target program is running, specify a memory data acquisition interval in ms units at which intervals you want memory data to be acquired one byte or word at a time by the RAM monitor function. The default interval time is 5 ms. The interval time specified here differs from the display update interval (sampling period) that you set in each window that supports the RAM monitor.

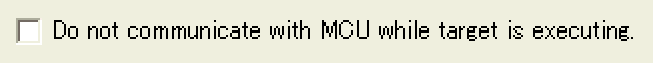


Data acquisition interval in MCU running state (1 - 10) ms

5 ms

5.1.3.4 Choosing to communicate or not to communicate with MCU while executing target program

Please specify whether to communicate with MCU while executing the target program.

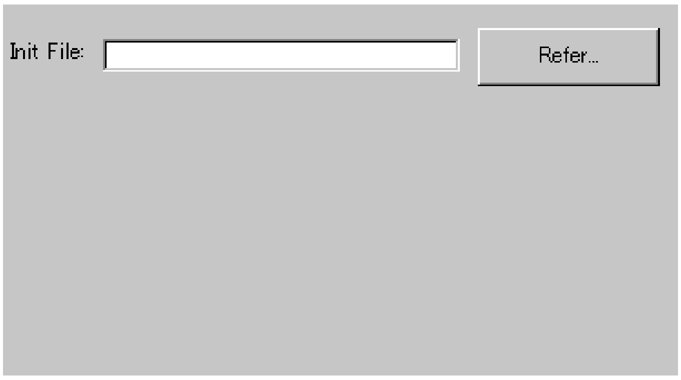


□ Do not communicate with MCU while target is executing.

Select the above check box when not communicating with MCU.
The communication fault occurs if it communicates with MCU while executing the WAIT/STOP instruction. In this case, please set not to communicate with MCU.

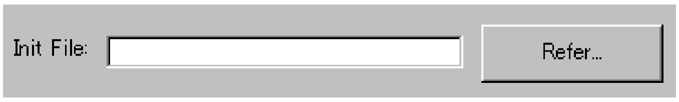
5.1.4 Script Tab

The specified content becomes effective when the next being start.



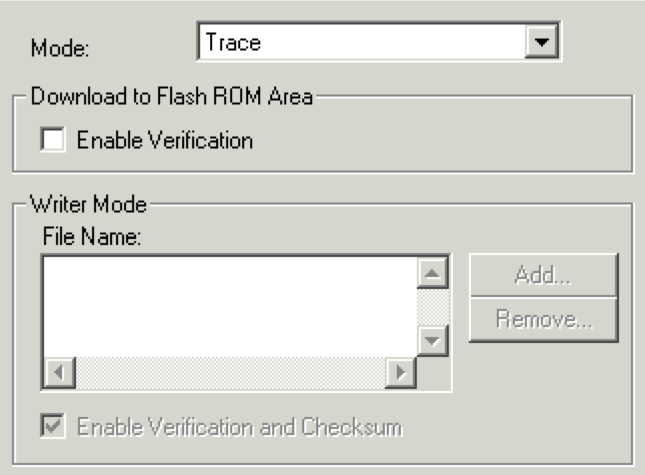
5.1.4.1 Automatically Execute the Script Commands

To automatically execute the script command at start of Debugger, click the "Refer" button to specify the script file to be executed.



By clicking the "Refer" button, the File Selection dialog is opened.
The specified script file is displayed in the "Init File:" field.
To disable auto-execution of the script command, erase a character string displayed in the "Init File:" field.

5.1.5 Debugging Mode Tab



Mode: Trace

Download to Flash ROM Area

□ Enable Verification

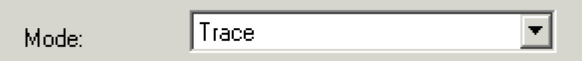
Writer Mode

File Name:

☑ Enable Verification and Checksum

5.1.5.1 Selecting of the Debugging Mode

Select the debugging mode of the emulator debugger.



Mode: Trace

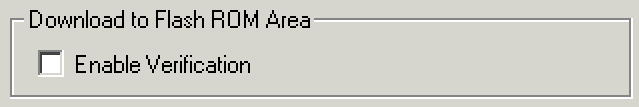
- The trace mode is the mode to use the trace function.
- The time measurement mode is the mode to use the time measurement function.
- The RAM monitor mode is the mode to use the RAM monitor function.
- The writer mode is the mode to use the emulator as a writer of the flash ROM.

The function of the mode except for the chosen mode can't be used.
The following shows the debugging function that can be used in each mode.

Mode	Debugging function							
	Break				Trace	Time measurement		RAM monitor
	Execution PC	Data access	Address Area	Data compare		Execution time	Interval time	
Trace : Trace priority	Yes	Yes	No	No	Yes	No	No	No
Trace : MCU execution priority	Yes	Yes	No	Yes	Yes	No	No	No
Time measurement	Yes	Yes	No	No	No	Yes	Yes	No
RAM monitor	Yes	Yes	Yes	No	No	No	No	Yes
Writer	No	No	No	No	No	No	No	No

5.1.5.2 Setting of Download to Flash ROM Area

When downloading the target program, specify whether or not to verify in the flash ROM area.
To use the verify function, select the "Enable Verification" check box.

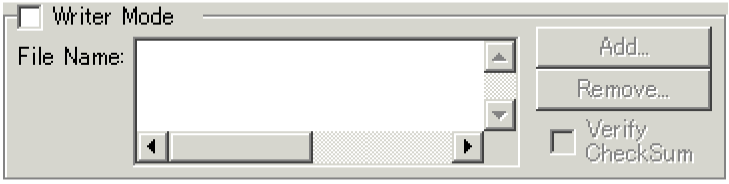


Download to Flash ROM Area

□ Enable Verification

5.1.5.3 Specifying Writer Mode

Specify writer mode when the emulator needs to be used as a flash ROM writer. The target program cannot be debugged in writer mode.
To specify writer mode, select the the load module file you want to download.
To select a file, click the Add button and select one in the ensuing dialog box. The selected file is listed in the file name column of the dialog box. Multiple files can be selected.
To delete a file from the list, select the file you want to delete and click the Remove button.
To use the verify and checksum functions, select the "Enable Verification and Checksum" check box.



□ Writer Mode

File Name:

□ Verify CheckSum

When the write operation is completed, restart or quit the emulator debugger.

ATTENTION

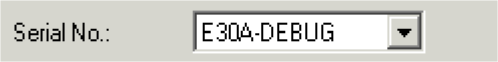
- Only when writer mode is selected in the Debugging Mode, writer function can be used.

5.2 Setting of the Communication Interface

5.2.1 Setting of the USB Interface

USB communication uses the personal computer's USB interface. It is compliant with USB 2.0.
Before USB communication can be performed, the computer must have a dedicated device driver installed in it. For details on how to install USB device drivers, see "3.3.1.1 Install of USB device driver."

The currently USB-connected emulators are listed in the Serial No. area. Select the serial No. of the emulator you want to connect.

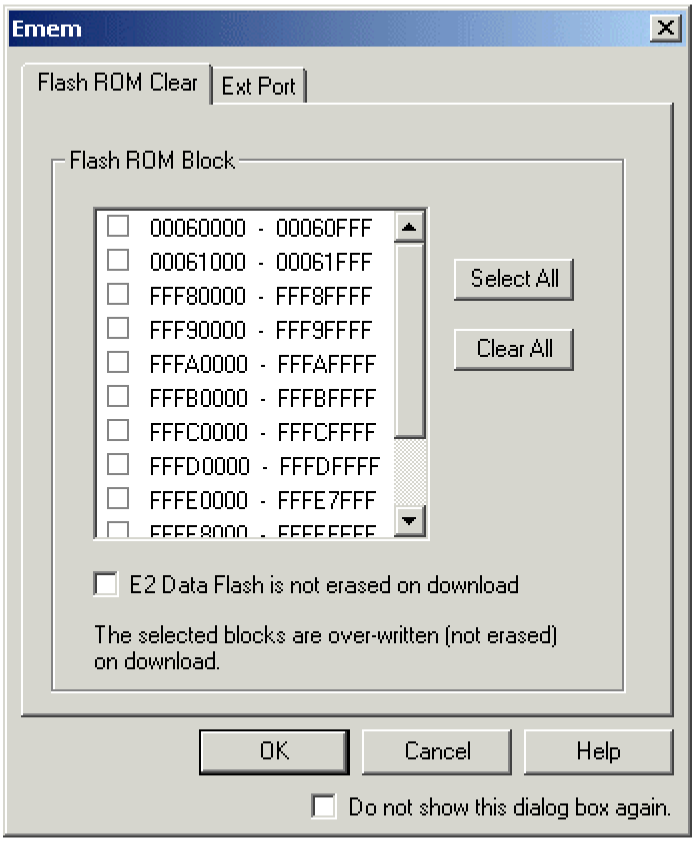


Serial No.: E30A-DEBUG

5.3 Setup the Debugger for R32C

5.3.1 Emem Dialog

In the Emem dialog box, setting information on the user target. The Emem dialog box opens after closing the Init dialog box.



Flash ROM Block

□ 00060000 - 00060FFF
□ 00061000 - 00061FFF
□ FFF80000 - FFF8FFFF
□ FFF90000 - FFF9FFFF
□ FFFA0000 - FFFAFFFF
□ FFFB0000 - FFFBFFFF
□ FFFC0000 - FFFCFFFF
□ FFFD0000 - FFFDFFFF
□ FFFE0000 - FFFE7FFF
□ FFFE8000 - FFFEFFFF

□ E2 Data Flash is not erased on download

The selected blocks are over-written (not erased) on download.

□ Do not show this dialog box again.

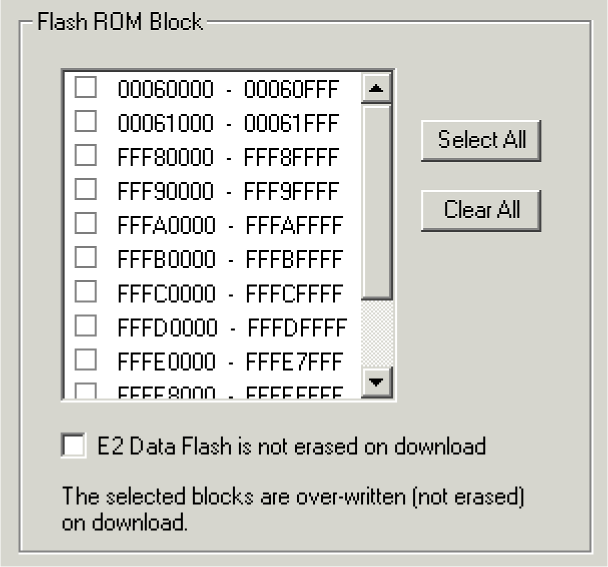
Tab Name	Contents
Flash ROM Clear	Specify whether or not to clear the contents of the MCU's internal flash ROM.
Ext Port	Specify whether or not to invalidate reset of the target.

You can open the Emem dialog using either one of the following methods:

- After the debugger gets started, select Menu - [Setup] -> [Emulator] -> [Target...].

5.3.1.1 Flash ROM Clear Tab

The specified content becomes effective when the next being start.



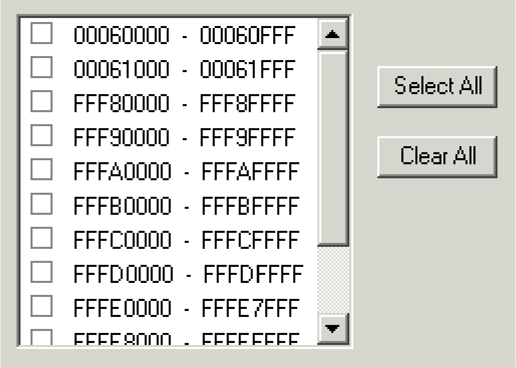
□ 00060000 - 00060FFF
□ 00061000 - 00061FFF
□ FFF80000 - FFF8FFFF
□ FFF90000 - FFF9FFFF
□ FFFA0000 - FFFAFFFF
□ FFFB0000 - FFFBFFFF
□ FFFC0000 - FFFCFFFF
□ FFFD0000 - FFFDFFFF
□ FFFE0000 - FFFE7FFF
□ FFFE8000 - FFFFFFFF

□ E2 Data Flash is not erased on download

The selected blocks are over-written (not erased) on download.

5.3.1.1.1. Setting to clear the MCU's internal flash ROM

Specify whether or not to clear the contents of the MCU's internal flash ROM when downloading the target program or data.



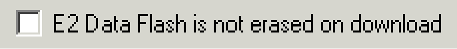
□ 00060000 - 00060FFF
□ 00061000 - 00061FFF
□ FFF80000 - FFF8FFFF
□ FFF90000 - FFF9FFFF
□ FFFA0000 - FFFAFFFF
□ FFFB0000 - FFFBFFFF
□ FFFC0000 - FFFCFFFF
□ FFFD0000 - FFFDFFFF
□ FFFE0000 - FFFE7FFF
□ FFFE8000 - FFFFFFFF

The MCU's internal flash ROM is displayed block by block in the list view.

- The blocks whose check marks are turned on do not have their flash contents cleared when downloading. The memory contents in places not overwritten by downloading remain intact.
- The blocks whose check marks are turned off have their flash contents cleared when downloading.
- Pressing the Select All button keeps all blocks from being cleared when downloading.
- Pressing the Clear All button clears all blocks when downloading.

5.3.1.1.2. Setting to clear the E2 Data Flash

Specify whether or not to clear the contents of the E2 Data Flash when downloading the target program or data.

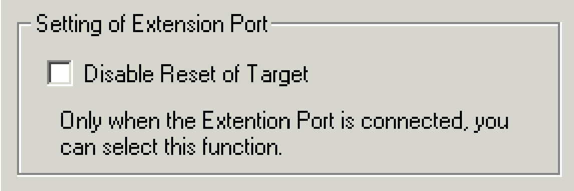


□ E2 Data Flash is not erased on download

Select the above check box when you do not clear the content of the E2 Data Flash when downloading.
The memory contents in places not overwritten by downloading remain intact.
This setting is invalid for MCU that doesn't support the E2 Data Flash.

5.3.1.2 Ext Port Tab

The specified content becomes effective when the next being start.



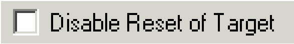
Setting of Extension Port

□ Disable Reset of Target

Only when the Extention Port is connected, you can select this function.

5.3.1.2.1. Setting to extension port

Specify whether or not to invalidate reset of the target.



□ Disable Reset of Target

- If you want to invalidate reset of the target, select the check box shown above. When the extension port is not connected, this function cannot be set.
- When the extension port is connected, this function can be changed even after debugger start.

Tutorial

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6. Tutorial

6.1 Introduction

This section describes the main functions of this debugger by using a tutorial program. The tutorial programs are installed to the directory ¥WorkSpace¥Tutorial of the drive you installed High-performance Embedded Workshop. There are workspaces for each targets and each MCUs. Please select the corresponding one to your system, and open the workspace file (*.hws) from the menu [Open Workspace...].

The tutorial program is based on the C program that sorts ten random data items in ascending or descending order. The tutorial program performs the following actions:

- The tutorial function generates random data to be sorted.
- The sort function sorts the generated random data in ascending order.
- The change function then sorts the data in descending order.

Note

After recompilation, the addresses may differ from those given in this section.

6.2 Usage

Please follow these instructions:

6.2.1 Step1 : Starting the Debugger

6.2.1.1 Preparation before Use

To run the High-performance Embedded Workshop and connect the emulator, refer to "4 Preparation before Use ".

6.2.1.2 Setup the Debugger

If it connects with an emulator, the dialog box for setting up a debugger will be displayed. Please set up the debugger in this dialog box.
To setup the debugger in this dialog box, refer to "5 Setup the Debugger ".
After the setup of a debugger, it will function as a debugger.

6.2.2 Step2 : Checking the Operation of RAM

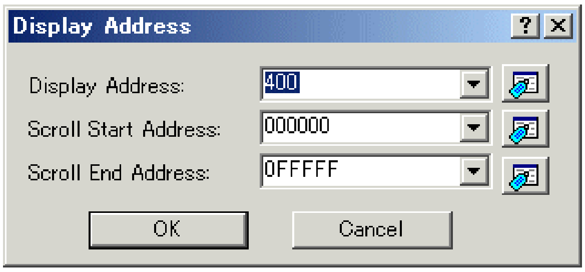
Check that RAM is operating correctly. Display and edit the contents of the memory in the [Memory] window to check that the memory is operating correctly.

Note

The memory can be installed on the board in some microcomputers. In this case, however, the above way of checking the operation of memory may be inadequate. It is recommended that a program for checking the memory be created.

6.2.2.1 Checking the Operation of RAM

Select [Memory] from the [CPU] submenu of the [View] menu and enter the RAM address (Here, enter “400”) in the [Display Address] edit boxes. The [Scroll Start Address] and [Scroll End Address] editing box is left to a default setting. (By default, the scroll range is set to 0h to the maximum address of MCU.)



Display Address: 400

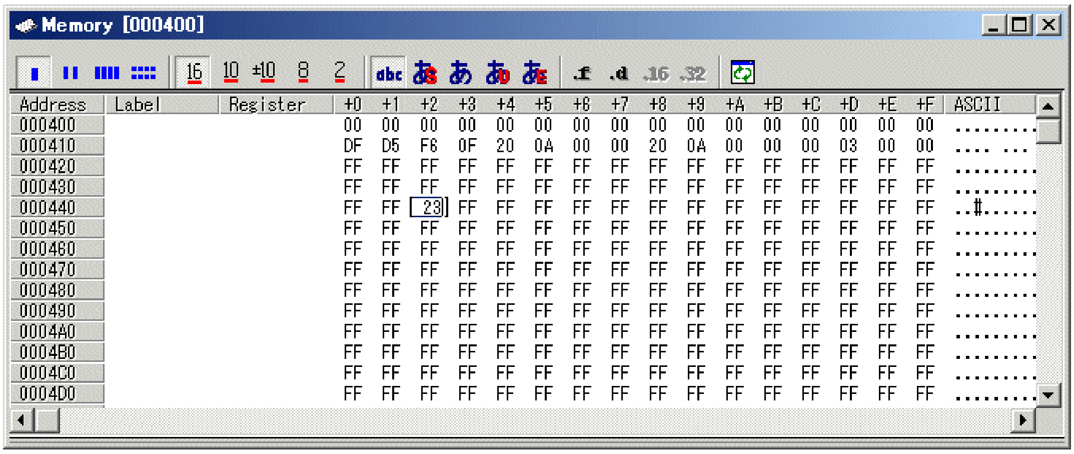
Scroll Start Address: 000000

Scroll End Address: 0FFFFF

Note

The settings of the RAM area differ depending on the product. For details, refer to the hardware manual.

Click the [OK] button. The [Memory] window is displayed and shows the specified memory area.



```
Address  Label   Register   +0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +A +B +C +D +E +F  ASCII
000400                      00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .........
000410                      DF D5 F6 0F 20 0A 00 00 20 0A 00 00 00 03 00 00  .... ...
000420                      FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  .........
000430                      FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  .........
000440                      FF FF 23 FF FF FF FF FF FF FF FF FF FF FF FF FF  ..#......
000450                      FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  .........
000460                      FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  .........
000470                      FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  .........
000480                      FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  .........
000490                      FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  .........
0004A0                      FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  .........
0004B0                      FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  .........
0004C0                      FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  .........
0004D0                      FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  .........
```

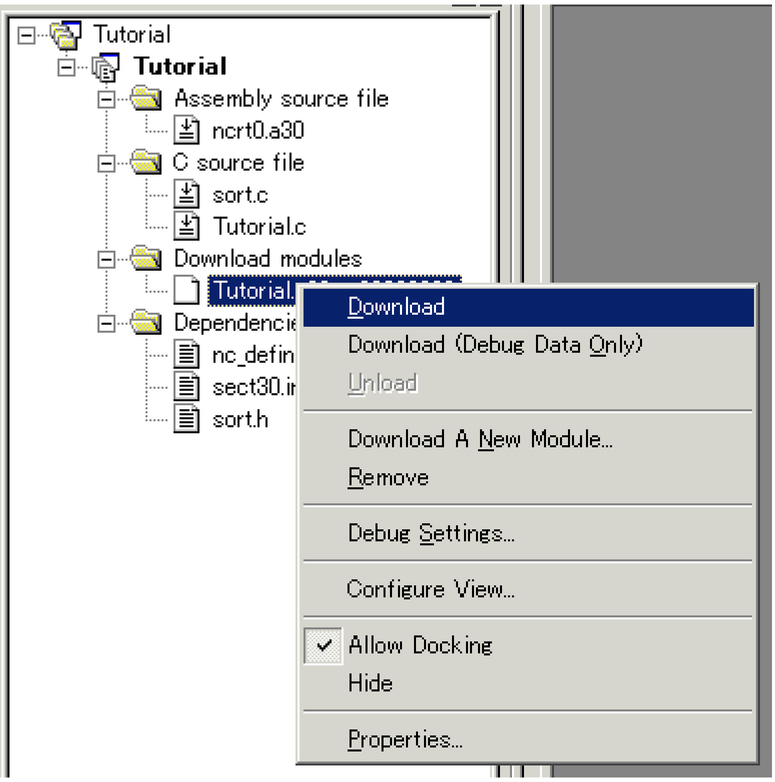
Placing the mouse cursor on a point in the display of data in the [Memory] window and double-clicking allows the values at that point to be changed.

6.2.3 Step3 : Downloading the Tutorial Program

6.2.3.1 Downloading the Tutorial Program

Download the object program to be debugged. The download file and the address to be downloaded will depends on the target mcu you uses. Please replace the screen image and addresses with corresponding one to your target mcu.

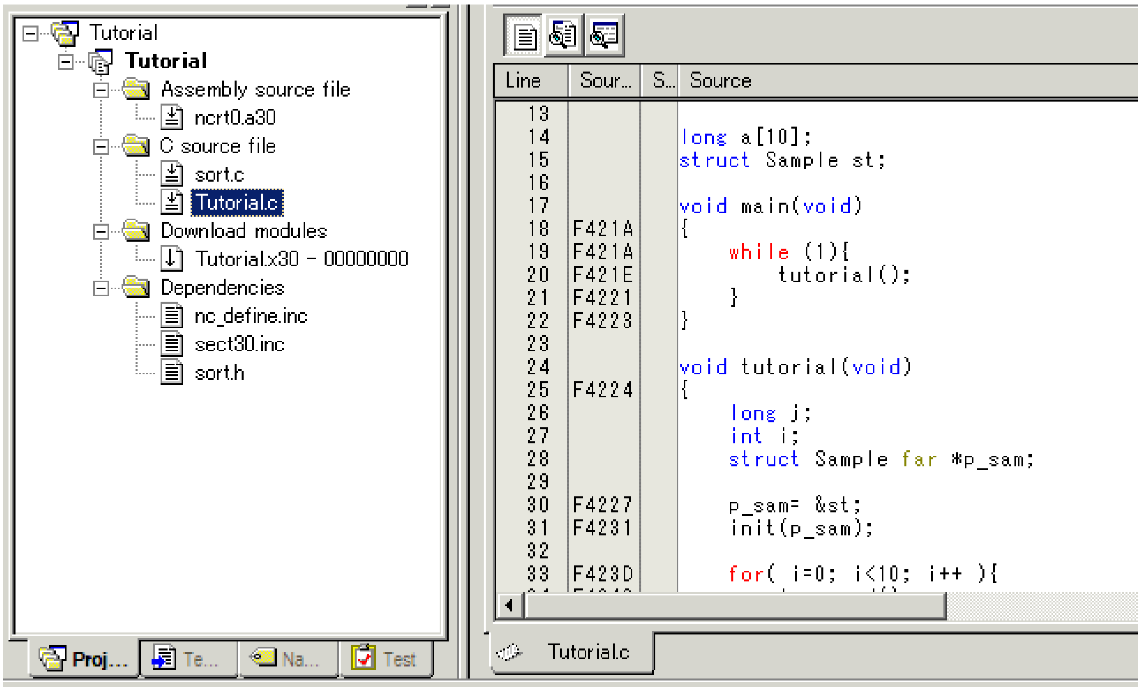
- The Debugger for M16C/R8C, M32C or R32C
  Select [Download module] from [Tutorial.x30] under [Download modules].



6.2.3.2 Displaying the Source Program

This debugger allows the user to debug a user program at the source level.

Double-click [tutorial.c] under [C source file]. A [Editor(Source)] window opens and the contents of a "Tutorial.c" file are displayed.



```
         long a[10];
         struct Sample st;

         void main(void)
F421A    {
F421A        while (1){
F421E            tutorial();
F4221        }
F4223    }

         void tutorial(void)
F4224    {
             long j;
             int i;
             struct Sample far *p_sam;

F4227        p_sam= &st;
F4231        init(p_sam);

F423D        for( i=0; i<10; i++ ){
```

Select the [Format Views...] option from the [Setup] menu to set a font and size that are legible, if necessary.

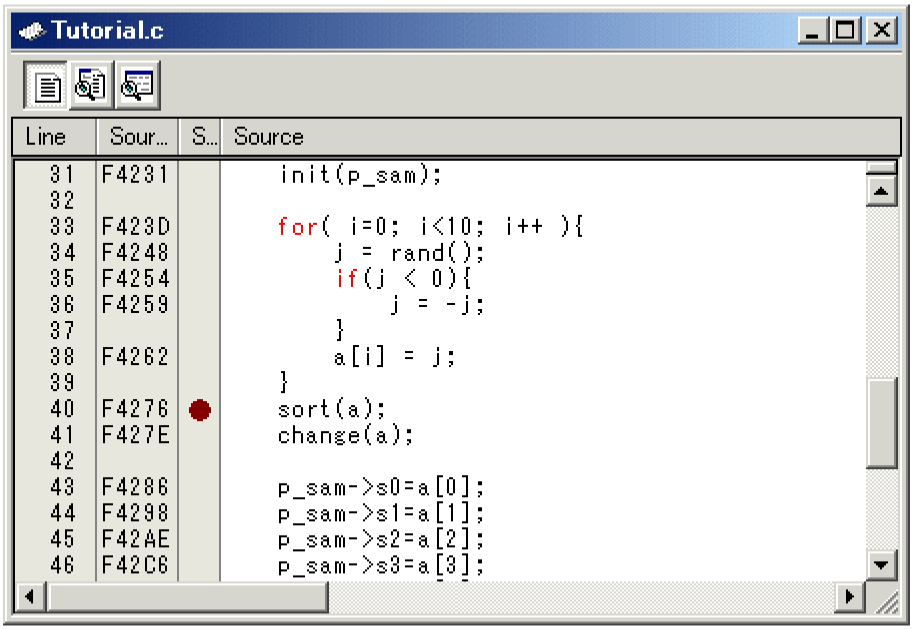
Initially the [Editor(Source)] window shows the start of the user program, but the user can use the scroll bar to scroll through the user program and look at the other statements.

6.2.4 Step4 : Setting a Breakpoint

A software breakpoint is a basic debugging function.
The [Editor(Source)] window provides a very simple way of setting a software breakpoint at any point in a program.

6.2.4.1 Setting a Software Breakpoint

For example, to set a software breakpoint at the sort function call:
Double-click the [S/W breakpoints] column on the line containing the sort function call.



Line	Sour...	S...	Source
31	F4231		init(p_sam);
32			
33	F423D		for(i=0; i<10; i++){
34	F4248		j = rand();
35	F4254		if(j < 0){
36	F4259		j = -j;
37			}
38	F4262		a[i] = j;
39			}
40	F4276	●	sort(a);
41	F427E		change(a);
42			
43	F4286		p_sam->s0=a[0];
44	F4298		p_sam->s1=a[1];
45	F42AE		p_sam->s2=a[2];
46	F42C6		p_sam->s3=a[3];

The red symbol will appear on the line containing the sort function call. This shows that a softwarebreak breakpoint has been set.

6.2.5 Step5 : Executing the Program

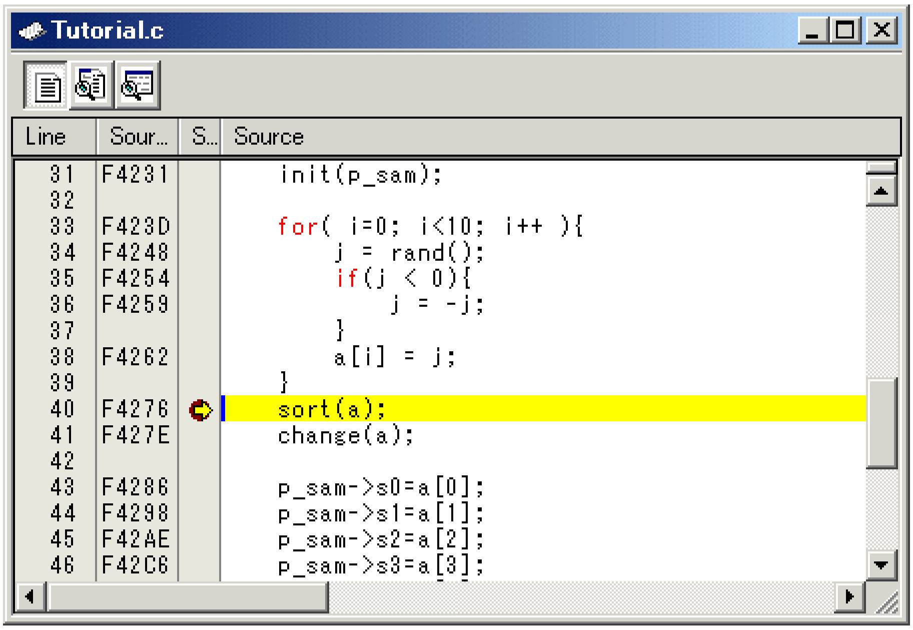
Execute the program as described in the following:

6.2.5.1 Resetting of CPU

To reset the CPU, select [Reset CPU] from the [Debug] menu, or click the [Reset CPU] button on the toolbar.

6.2.5.2 Executing the Program

To execute the program, select [Go] from the [Debug] menu, or click the [Go] button on the toolbar.
The program will be executed up to the breakpoint that has been set, and an arrow will be displayed in the [S/W Breakpoints] column to show the position that the program has halted.



Tutorial.c

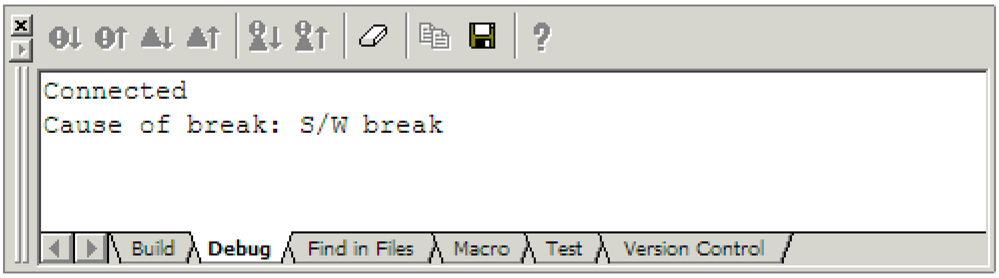
```
Line  Sour...  S...  Source
 31   F4231            init(p_sam);
 32
 33   F423D            for( i=0; i<10; i++ ){
 34   F4248                j = rand();
 35   F4254                if(j < 0){
 36   F4259                    j = -j;
 37                        }
 38   F4262                a[i] = j;
 39                    }
 40   F4276    ➡       sort(a);
 41   F427E            change(a);
 42
 43   F4286            p_sam->s0=a[0];
 44   F4298            p_sam->s1=a[1];
 45   F42AE            p_sam->s2=a[2];
 46   F42C6            p_sam->s3=a[3];
```

Note

When the source file is displayed after a break, a path of the source file may be inquired. In this case, please specify the location of a source file.

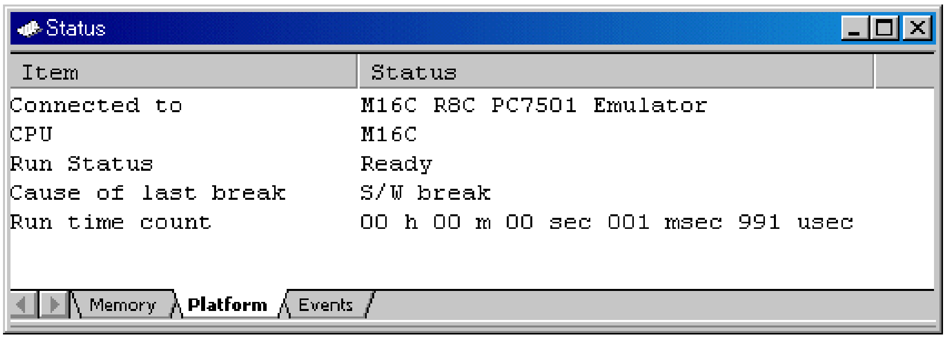
6.2.5.3 Reviewing Cause of the Break

The break factor is displayed in the [Output] window.



```
Connected
Cause of break: S/W break
```

The user can also see the cause of the break that occurred last time in the [Status] window.
Select [Status] from the [CPU] submenu of the [View] menu. After the [Status] window is displayed, open the [Platform] sheet, and check the Status of Cause of last break.



Item	Status
Connected to	M16C R8C PC7501 Emulator
CPU	M16C
Run Status	Ready
Cause of last break	S/W break
Run time count	00 h 00 m 00 sec 001 msec 991 usec

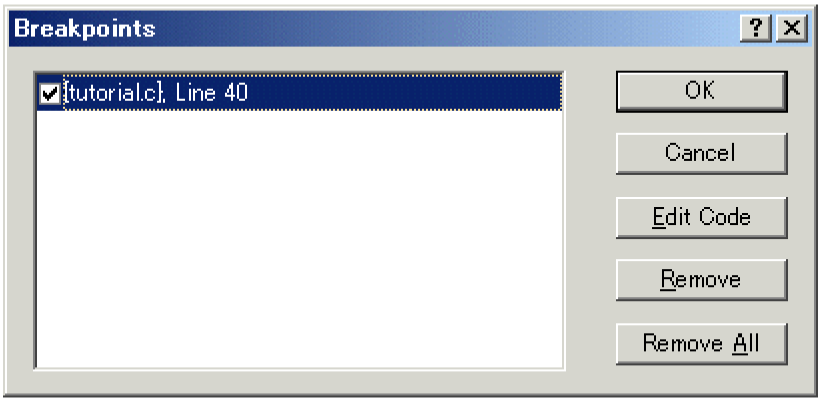
Please refer to "11 Display the Cause of the Program Stoppage " about the notation of a break factor.

6.2.6 Step6 : Reviewing Breakpoints

The user can see all the breakpoints set in the program in the [Breakpoints] dialog box.

6.2.6.1 Reviewing Breakpoints

Push the key Ctrl+B, and the [Breakpoints] dialog box will be displayed.



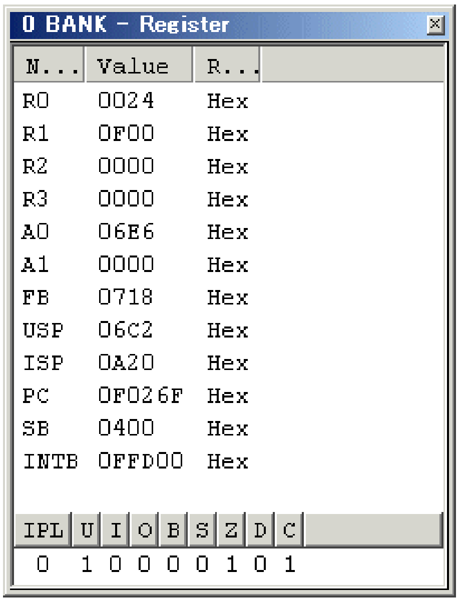
This window allows the user to delete, enable, or disable breakpoints.

6.2.7 Step7 : Viewing Register

The user can see all registers/flags value in the [Register] window.

6.2.7.1 Viewing Register

Select [Registers] from the [CPU] submenu of the [View] menu. The [Register] window is displayed.
The figure below shows a Register window of the debugger for M16C/R8C.



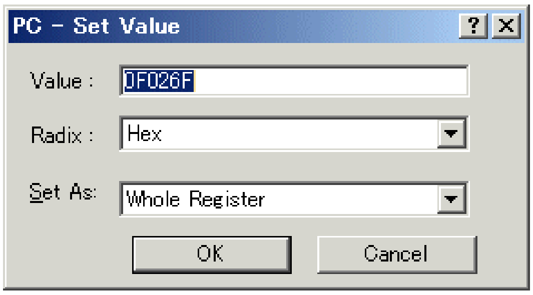
0 BANK – Register

N...	Value	R...
R0	0024	Hex
R1	0F00	Hex
R2	0000	Hex
R3	0000	Hex
A0	06E6	Hex
A1	0000	Hex
FB	0718	Hex
USP	06C2	Hex
ISP	0A20	Hex
PC	0F026F	Hex
SB	0400	Hex
INTB	0FFD00	Hex

IPL	U	I	O	B	S	Z	D	C
0	1	0	0	0	0	1	0	1

6.2.7.2 Setting the Register Value

You can change a register/flag value from this window.
Double-click the register line to be changed. The dialog is opened. Enter the value to be changed.



PC – Set Value

Value : 0F026F

Radix : Hex

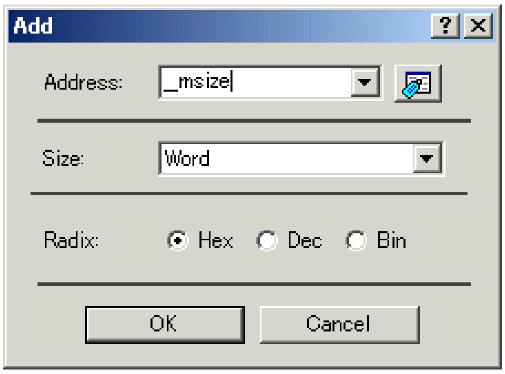
Set As: Whole Register

6.2.8 Step8 : Viewing Memory

When the label name is specified, the user can view the memory contents that the label has been registered in the [ASM Watch] window.

6.2.8.1 Viewing Memory

For example, to view the memory contents corresponding to __msize in word size:
Select [ASM Watch] from the [Symbol] submenu of the [View] menu, open the [ASM Watch] window.
And click the [ASM Watch] window with the right-hand mouse button and select [Add...] from the popup menu, enter __msize in the [Address] edit box, and set Word in the [Size] combo box.



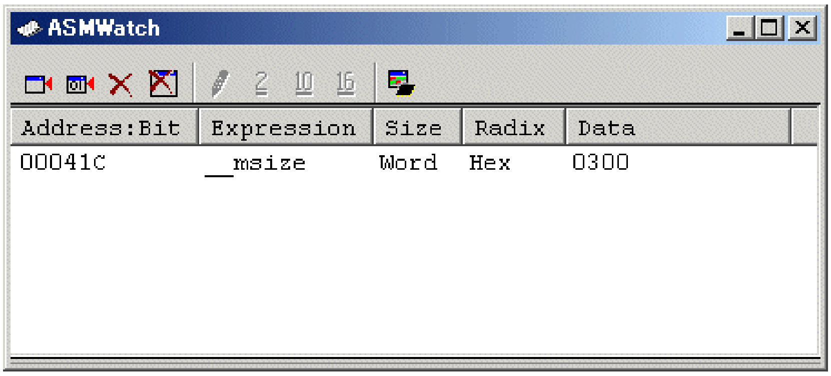
Add

Address: _msize

Size: Word

Radix: ● Hex ○ Dec ○ Bin

Click the [OK] button. The [ASM Watch] window showing the specified area of memory is displayed.



ASMWatch

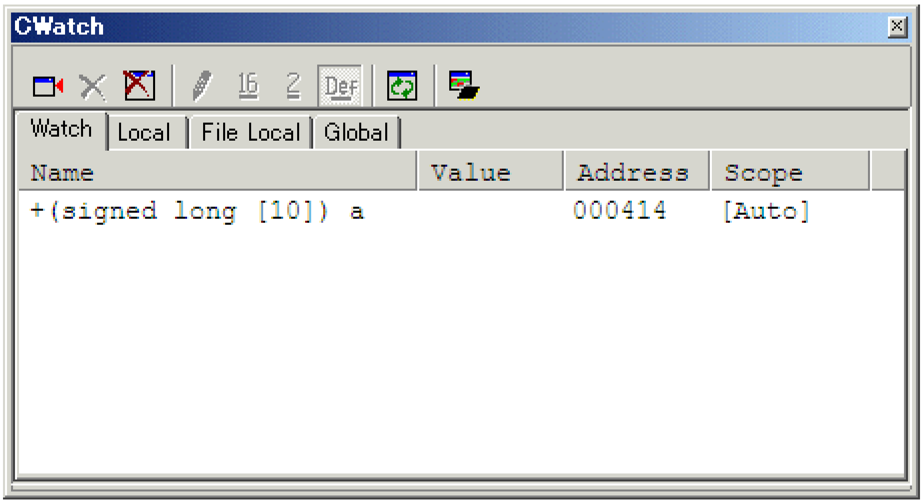
Address:Bit	Expression	Size	Radix	Data
00041C	__msize	Word	Hex	0300

6.2.9 Step9 : Watching Variables

As the user steps through a program, it is possible to watch that the values of variables used in the user program are changed.

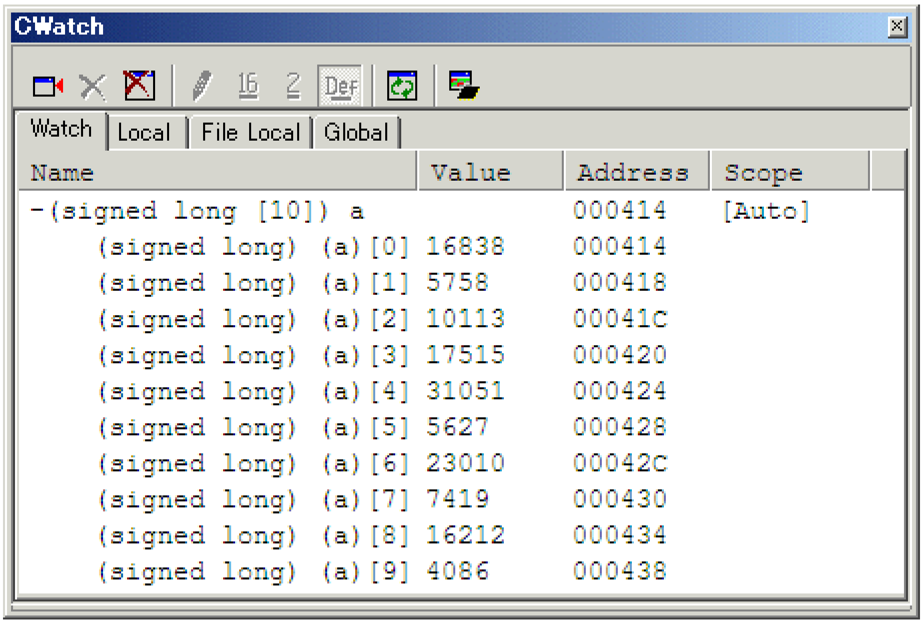
6.2.9.1 Watching Variables

For example, set a watch on the long-type array a declared at the beginning of the program, by using the following procedure:
Click the left of displayed array a in the [Editor(Source)] window to position the cursor, and select [Add C Watch...] with the right-hand mouse button. The [Watch] tab of [C watch] window in which the variable is displayed opens.



Name	Value	Address	Scope
+(signed long [10]) a		000414	[Auto]

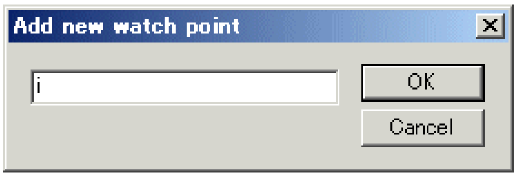
The user can click mark '+' at the left side of array a in the [C Watch] window to watch all the elements.



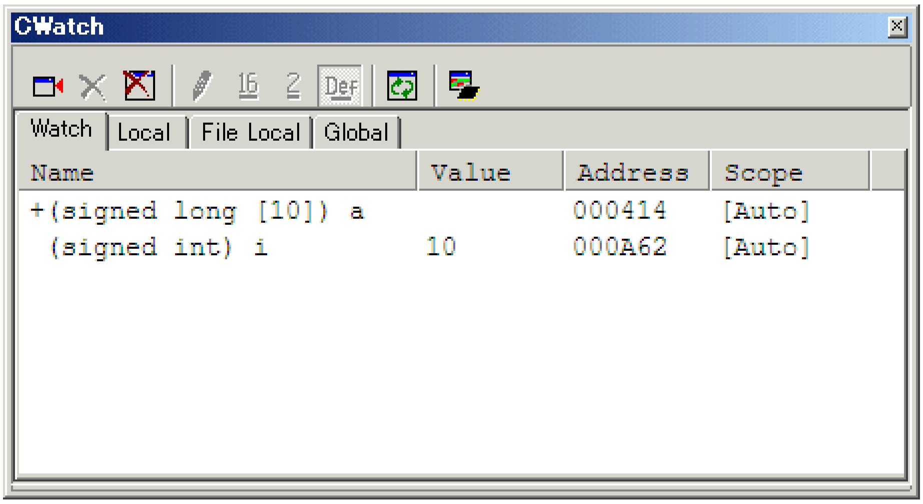
Name	Value	Address	Scope
-(signed long [10]) a		000414	[Auto]
(signed long) (a)[0]	16838	000414	
(signed long) (a)[1]	5758	000418	
(signed long) (a)[2]	10113	00041C	
(signed long) (a)[3]	17515	000420	
(signed long) (a)[4]	31051	000424	
(signed long) (a)[5]	5627	000428	
(signed long) (a)[6]	23010	00042C	
(signed long) (a)[7]	7419	000430	
(signed long) (a)[8]	16212	000434	
(signed long) (a)[9]	4086	000438	

6.2.9.2 Registering Variable

The user can also add a variable to the [C Watch] window by specifying its name.
Click the [C Watch] window with the right-hand mouse button and select [Add...] from the popup menu.
The following dialog box will be displayed. Enter variable i.



Click the [OK] button. The [C Watch] window will now also show the int-type variable i.



Name	Value	Address	Scope
+(signed long [10]) a		000414	[Auto]
(signed int) i	10	000A62	[Auto]

6.2.10 Step10 : Stepping Through a Program

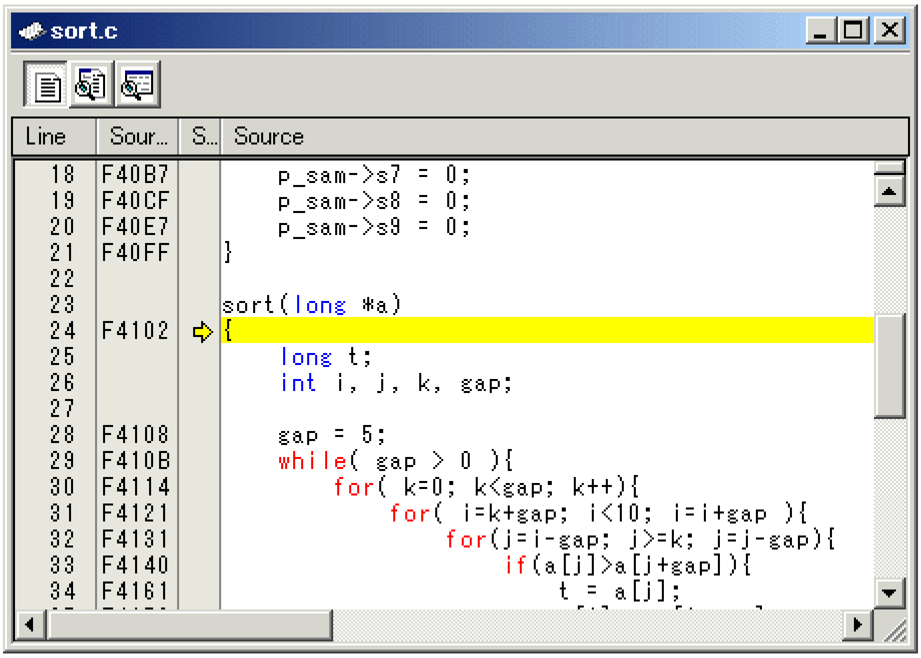
This debugger provides a range of step menu commands that allow efficient program debugging.

1. Step In
   Executes each statement, including statements within functions(subroutines).
2. Step Out
   Steps out of a function(subroutine), and stops at the statement following the statement in the program that called the function(subroutine).
3. Step Over
   Executes a function(subroutine) call in a single step.
4. Step...
   Steps the specified times repeatedly at a specified rate.

6.2.10.1 Executing [Step In] Command

The [Step In] command steps into the called function(subroutine) and stops at the first statement of the called function(subroutine).

To step through the sort function, select [Step In] from the [Debug] menu, or click the [Step In] button on the toolbar.
The PC cursor moves to the first statement of the sort function in the [Editor(Source)] window.

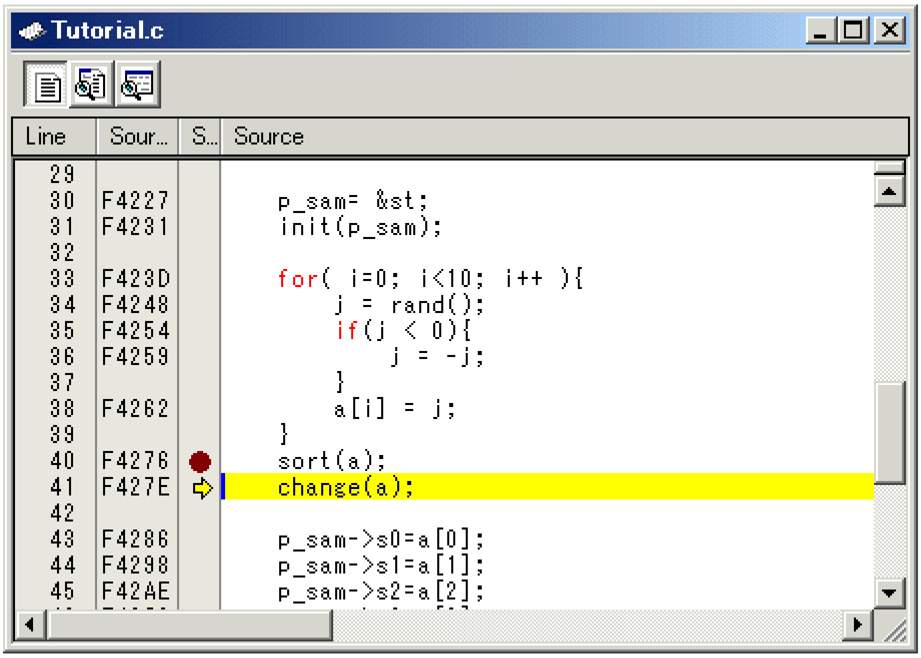


```
Line  Sour...  S...  Source
 18   F40B7              p_sam->s7 = 0;
 19   F40CF              p_sam->s8 = 0;
 20   F40E7              p_sam->s9 = 0;
 21   F40FF         }
 22
 23                 sort(long *a)
 24   F4102    ⇨    {
 25                      long t;
 26                      int i, j, k, gap;
 27
 28   F4108              gap = 5;
 29   F410B              while( gap > 0 ){
 30   F4114                  for( k=0; k<gap; k++){
 31   F4121                      for( i=k+gap; i<10; i=i+gap ){
 32   F4131                          for(j=i-gap; j>=k; j=j-gap){
 33   F4140                              if(a[j]>a[j+gap]){
 34   F4161                                  t = a[j];
```

6.2.10.2 Executing [Step Out] Command

The [Step Out] command steps out of the called function(subroutine) and stops at the next statement of the calling statement in the main function.

To step out of the sort function, select [Step Out] from the [Debug] menu, or click the [Step Out] button on the toolbar.
The PC cursor slips out of a sort function, and moves to the position before a change function.



```
F4227       p_sam= &st;
F4231       init(p_sam);

F423D       for( i=0; i<10; i++ ){
F4248           j = rand();
F4254           if(j < 0){
F4259               j = -j;
                }
F4262           a[i] = j;
            }
F4276  ●    sort(a);
F427E  ⇨    change(a);

F4286       p_sam->s0=a[0];
F4298       p_sam->s1=a[1];
F42AE       p_sam->s2=a[2];
```

Note

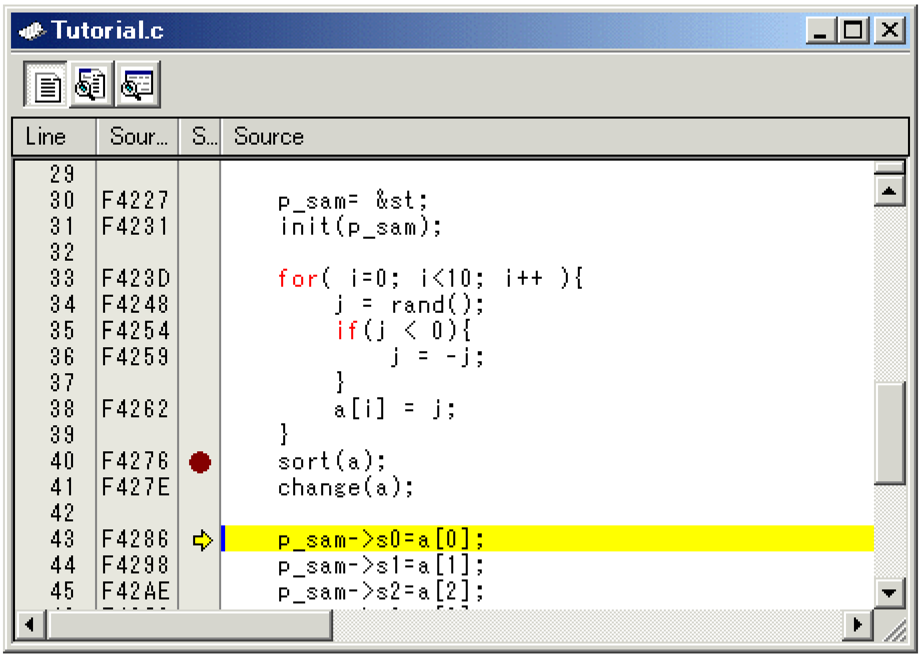
It takes time to execute this function. When the calling source is clarified, use [Go To Cursor].

6.2.10.3 Executing [Step Over] Command

The [Step Over] command executes a function (subroutine) call as a single step and stops at the next statement of the main program.

To step through all statements in the change function at a single step, select [Step Over] from the [Debug] menu, or click the [Step Over] button on the toolbar.

The PC cursor moves to the next position of a change function.



```
F4227      p_sam= &st;
F4231      init(p_sam);

F423D      for( i=0; i<10; i++ ){
F4248          j = rand();
F4254          if(j < 0){
F4259              j = -j;
               }
F4262          a[i] = j;
           }
F4276  ●   sort(a);
F427E      change(a);

F4286  ⇨   p_sam->s0=a[0];
F4298      p_sam->s1=a[1];
F42AE      p_sam->s2=a[2];
```

6.2.11 Step11：Forced Breaking of Program Executions

This debugger can force a break in the execution of a program.

6.2.11.1 Forced Breaking of Program Executions

Cancel all breaks.

To execute the remaining sections of the main function, select [Go] from the [Debug] menu or the [Go] button on the toolbar.
The program goes into an endless loop. To force a break in execution, select [Halt Program] from the [Debug] menu or the [Halt] button STOP on the toolbar.

6.2.12 Step12：Displaying Local Variables

The user can display local variables in a function using the [C Watch] window.

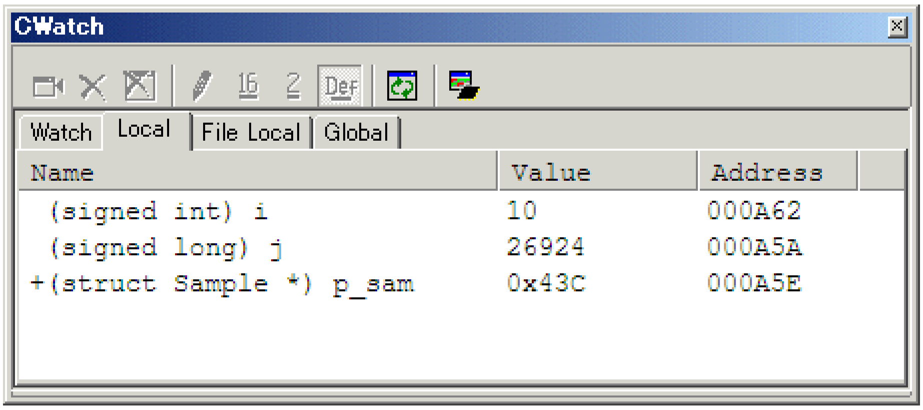
6.2.12.1 Displaying Local Variables

For example, we will examine the local variables in the tutorial function, which declares three local variables: i, j, and p_sam.

Select [C Watch] from the [Symbol] submenu of the [View] menu. The [C Watch] window is displayed. By default, [C watch] window has four tabs as following:

- [Watch] tab
  Only the variable which the user registered is displayed.
- [Local] tab
  All the local variables that can be referred to by the scope in which the the PC exists are displayed. If a scope is changed by program execution, the contents of the [Local] tab will also change.
- [File Local] tab
  All the file local variables of the file scope in which the PC exists are displayed. If a file scope is changed by program execution, the contents of the [File Local] tab will also change.
- [Global] tab
  All the global variables currently used by the downloaded program are displayed.

Please choose the [Local] tab, when you display a local variable.



Name	Value	Address
(signed int) i	10	000A62
(signed long) j	26924	000A5A
+(struct Sample *) p_sam	0x43C	000A5E

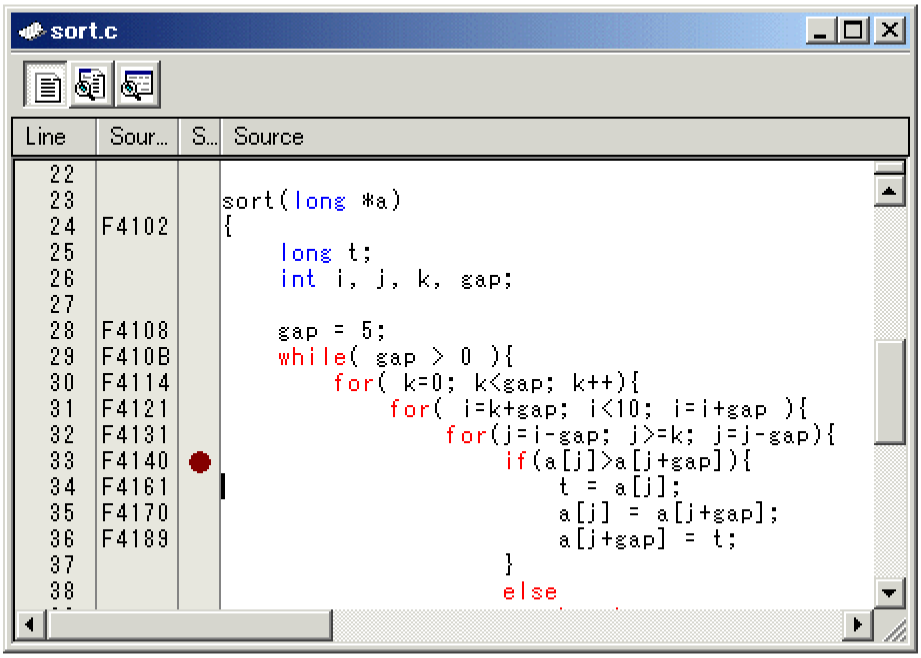
Double-click the mark '+' at the left side of pointer p_sam in the [Locals] window to display the structure *(p_sam). When the user refers to the members of the structure at the end of the Tutorial function, it is clarified that random data is sorted in descending order.

6.2.13 Step13 : Stack Trace Function

The debugger uses the information on the stack to display the names of functions in the sequence of calls that led to the function to which the program counter is currently pointing.

6.2.13.1 Reference the function call status

Double-click the [S/W Breakpoints] column in the sort function and set a software breakpoint.

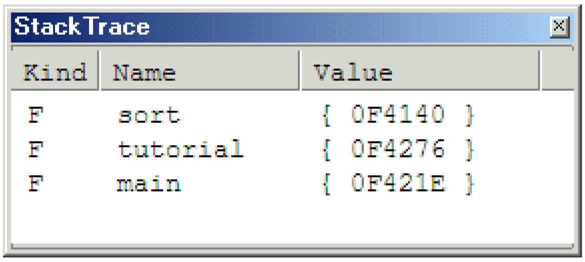


```
             sort(long *a)
F4102        {
                 long t;
                 int i, j, k, gap;

F4108            gap = 5;
F410B            while( gap > 0 ){
F4114                for( k=0; k<gap; k++){
F4121                    for( i=k+gap; i<10; i=i+gap ){
F4131                        for(j=i-gap; j>=k; j=j-gap){
F4140   ●                        if(a[j]>a[j+gap]){
F4161                                t = a[j];
F4170                                a[j] = a[j+gap];
F4189                                a[j+gap] = t;
                                 }
                                 else
```

To executes the user program from the reset vector address, select [Reset Go] from the [Debug] menu, or click the [Reset Go] button on the toolbar.

After the break in program execution, select [Stack Trace] from the [Code] submenu of the [View] menu to open the [Stack Trace] window.



Kind	Name	Value
F	sort	{ 0F4140 }
F	tutorial	{ 0F4276 }
F	main	{ 0F421E }

The upper figure shows that the position of the program counter is currently at the selected line of the sort() function, and that the sort() function is called from the tutorial() function.

6.2.14 What Next?

This tutorial has described the usage of this debugger.

Sophisticated debugging can be carried out by using the emulation functions that the emulator offers. This provides for effective investigation of hardware and software problems by accurately isolating and identifying the conditions under which such problems arise.

Reference

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7. Windows/Dialogs

The window of this debugger is shown below.

Window Name	View Menu
RAM Monitor Window	[View]->[CPU]->[RamMonitor]
ASM Watch Window	[View]->[Symbol]->[ASMWatch]
C Watch Window	[View]->[Symbol]->[CWatch]
Script Window	[View]->[Script]
S/W Break Point Setting Window	[View]->[Break]->[S/W Break Points]
Event Setting Window	[View]->[Trace]->[Trace Points] [View]->[Break]->[H/W Break Points]
Time Measurement Window	[View]->[Trace]->[Time Measure]
Trace Window	[View]->[Trace]->[Trace]
GUI I/O Window	[View]->[Graphic]->[GUI I/O]
MR Window	[View]->[RTOS]->[MR]

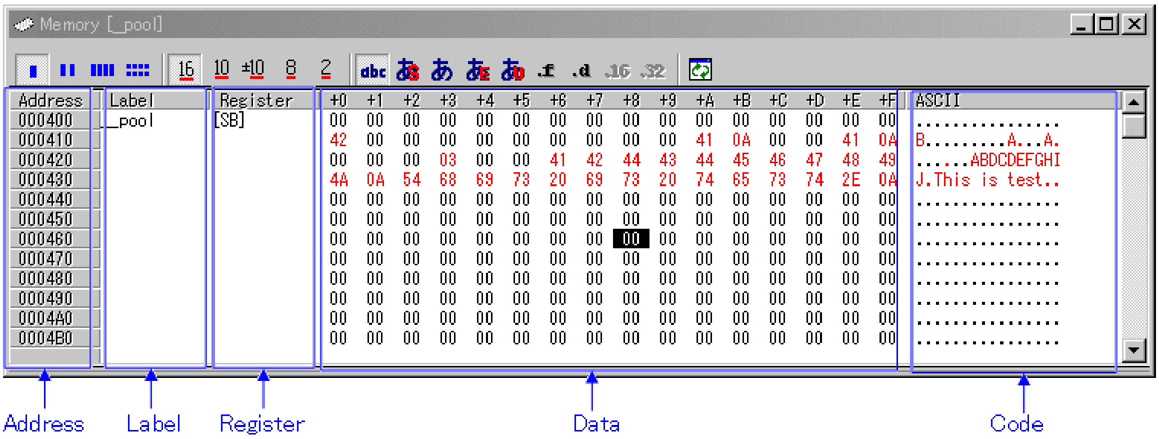
For the reference of the following windows, refer to the help attached to a High-performance Embedded Workshop main part.

- Differences Window
- Map Window
- Command Line Window
- Workspace Window
- Output Window
- Disassembly Window
- Memory Window
- IO Window
- Status Window
- Register Window
- Image Window
- Waveform Window
- Stack Trace Window

7.1 RAM Monitor Window

The RAM monitor window is a window in which changes of memory contents are displayed while running the target program.

The displayed contents are updated at given intervals while running the target program.



```
Address  Label  Register  +0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +A +B +C +D +E +F  ASCII
000400   _pool  [SB]      00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000410                    42 00 00 00 00 00 00 00 00 00 41 0A 00 00 41 0A  B.........A...A.
000420                    00 00 00 03 00 00 41 42 44 43 44 45 46 47 48 49  ......ABDCDEFGHI
000430                    4A 0A 54 68 69 73 20 69 73 20 74 65 73 74 2E 0A  J.This is test..
000440                    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000450                    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000460                    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000470                    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000480                    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000490                    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0004A0                    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
0004B0                    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
```

- This system has 1 Kbytes of RAM monitor area which can be located in any contiguous address location or in 64 separate blocks comprised of 16 bytes each.
- The RAM monitor area can be changed to any desired address range.
  Refer to "7.1.2 Setting the RAM monitor area" for details on how to change the RAM monitor area.
- The display content updating interval can be set for each window individually.
  The actual updating interval at which the display contents are actually updated while running the target program is shown in the title field of the Address display area.

ATTENTION

- The interval time at which intervals the display is updated may be longer than the specified interval depending on the operating condition (shown below).

- Host machine performance/load condition
- Communication interface
- Window size (memory display range) or the number of windows displayed

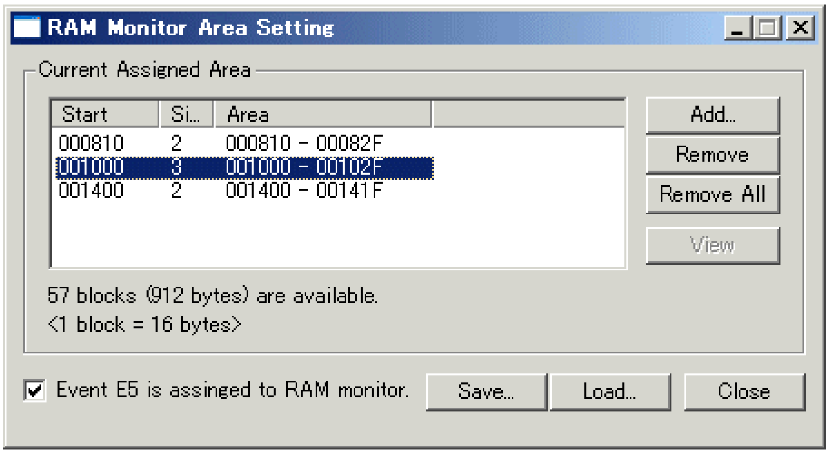
7.1.1 Extended Menus

This window has the following popup menus that can be brought up by right-clicking in the window.

Menu		Function
RAM Monitor Area...		Set RAM monitor base address.
Sampling Period...		Set RAM monitor sampling period.
Clear		Clear access attribute.
Up		Moves display position to the immediately preceding RAM monitor area (smaller address)
Down		Moves display position to the immediately following RAM monitor area (larger address)
Address...		Display from specified address.
Scroll Area...		Specify scroll range.
Data Length	1byte	Display in 1Byte unit.
	2bytes	Display in 2Byte unit.
	4bytes	Display in 4Byte unit.
	8bytes	Display in 8Byte unit.
Radix	Hex	Display in Hexadecimal.
	Dec	Display in Decimal.
	Single Dec	Display in Signed Decimal.
	Oct	Display in Octdecimal.
	Bin	Display in Binary.
Code	ASCII	Display as ASCII character.
	SJIS	Display as SJIS character.
	JIS	Display as JIS character.
	UNICODE	Display as UNICODE character.
	EUC	Display as EUC character.
	Float	Display as Floating-point.
	Double	Display as Double Floating-point.
Layout	Label	Switch display or non-display of Label area.
	Register	Switch display or non-display of Register area.
	Code	Switch display or non-display of Code area.
Column...		Set the number of columns displayed on one line.
Split		Split window.
Toolbar display		Display toolbar.
Customize toolbar...		Open toolbar customize dialog box.
Allow Docking		Allow window docking.
Hide		Hide window.

7.1.2 Setting the RAM monitor area

Choose the popup menu [RAM Monitor Area...] in the RAM monitor window.
The RAM monitor area setup window shown below will appear. The currently set RAM monitor areas are listed in this window.



Start	Si...	Area
000810	2	000810 - 00082F
001000	3	001000 - 00102F
001400	2	001400 - 00141F

57 blocks (912 bytes) are available.
<1 block = 16 bytes>

☑ Event E5 is assinged to RAM monitor.

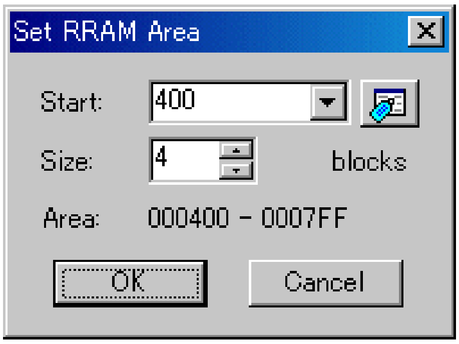
Use this window to add, delete or change RAM monitor areas.

- Specify a RAM monitor area by its start address and size (the latter by a number of blocks.)
- The start address can be specified in 0x10 byte units.
  If you specify a non-aligned address value, it is rounded off to the nearest address value in 0x10 byte units before being set.
- Specify the size of the RAM monitor area by a number of blocks.
  For the E30A, one block is 16 bytes in size. Up to 64 blocks can be specified.
- RAM monitor areas can be added until the total number of blocks used reaches 64.
  (The number of blocks (and the size) that are currently available to use are displayed below the list.)

7.1.2.1 Changing the RAM Monitor Area

The start address and the size of the RAM monitor area can be changed.

- Changing from a dialog box
  Select the RAM monitor area you want to change from a list of RAM monitor areas and double-click on it.
  The Set RRAM Area dialog box shown below will appear. Specify the start address and the size (by a number of blocks) of the RAM monitor area in the Start and the Size fields of this dialog box.



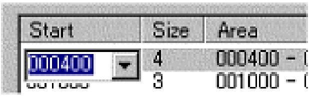
Set RRAM Area

Start: 400

Size: 4 blocks

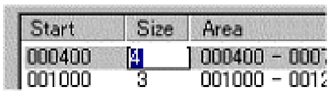
Area: 000400 - 0007FF

- Changing directly in the window
  Select the RAM monitor area you want to change from a list of RAM monitor areas and click again in its Start display column or Size display column.
  Specify a new start address or a new size with which you want to be changed in the ensuing edit box. Press the Enter key to confirm what you've entered, or the Esc key to cancel.



Start	Size	Area
000400	4	000400 - (
001000	3	001000 - (

Changing the address



Start	Size	Area
000400	4	000400 - 0007
001000	3	001000 - 0012

Changing the size

7.1.2.2 Adding RAM Monitor Areas

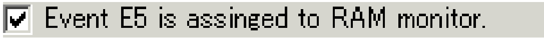
Click the [Add...] button.
The Set RRAM Area dialog box will appear. Specify the start address and the size (by a number of blocks) of a new RAM monitor area in the Start and the Size fields of this dialog box.

7.1.2.3 Deleting RAM Monitor Areas

Select the RAM monitor area you want to delete from a list of RAM monitor areas and click the [Remove] button.
To delete all RAM monitor areas, click the [Remove All] button.

7.1.2.4 Setting the RAM monitor event

To set the RAM monitor event, select the below check box.



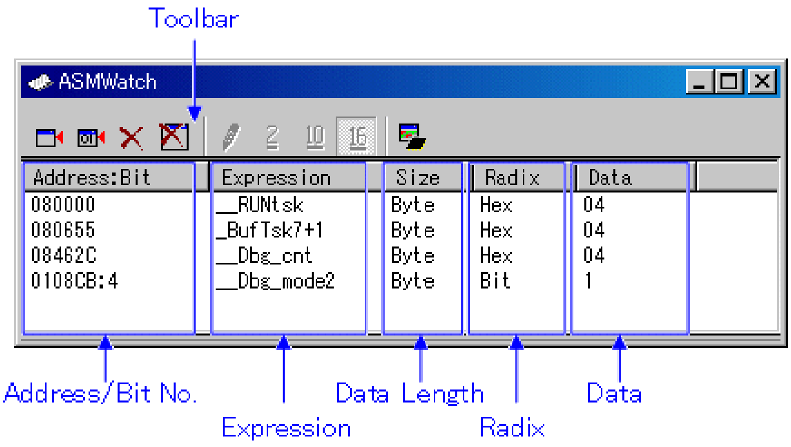
☑ Event E5 is assinged to RAM monitor.

The RAM monitor event is set to the event E5.
Please note that the RAM monitor function doesn't operate when the RAM monitor event is not set.

7.2 ASM Watch Window

The ASM watch window is a window in which you can register specific addresses as watchpoints and inspect memory contents at those addresses.

If a registered address resides within the RAM monitor area, the memory content at that address is updated at given intervals (by default, every 100 ms) during program execution.



Address:Bit	Expression	Size	Radix	Data
080000	__RUNtsk	Byte	Hex	04
080655	_BufTsk7+1	Byte	Hex	04
08462C	__Dbg_cnt	Byte	Hex	04
0108CB:4	__Dbg_mode2	Byte	Bit	1

- The addresses to be registered are called the "watchpoints." One of the following can be registered:
  - Address (can be specified using a symbol)
  - Address + Bit number
  - Bit symbol
- The registered watchpoints are saved in the debugger when the ASM watch window is closed and are automatically registered when the window is reopened.
- If symbols or bit symbols are specified for the watchpoints, the watchpoint addresses are recalculated when downloading the target program.
- The invalid watchpoints are marked by "-<not active>-" when displayed on the screen.
- The order in which the watchpoints are listed can be changed by a drag-and-drop operation.
- The watchpoint expressions, sizes, radixes and datas can be changed by in-place editing.

ATTENTION

- The RAM monitor function of this debugger is realized with memory dump. Real-time capability is impaired when this function is used.
- The background color by the access attribute cannot be changed.

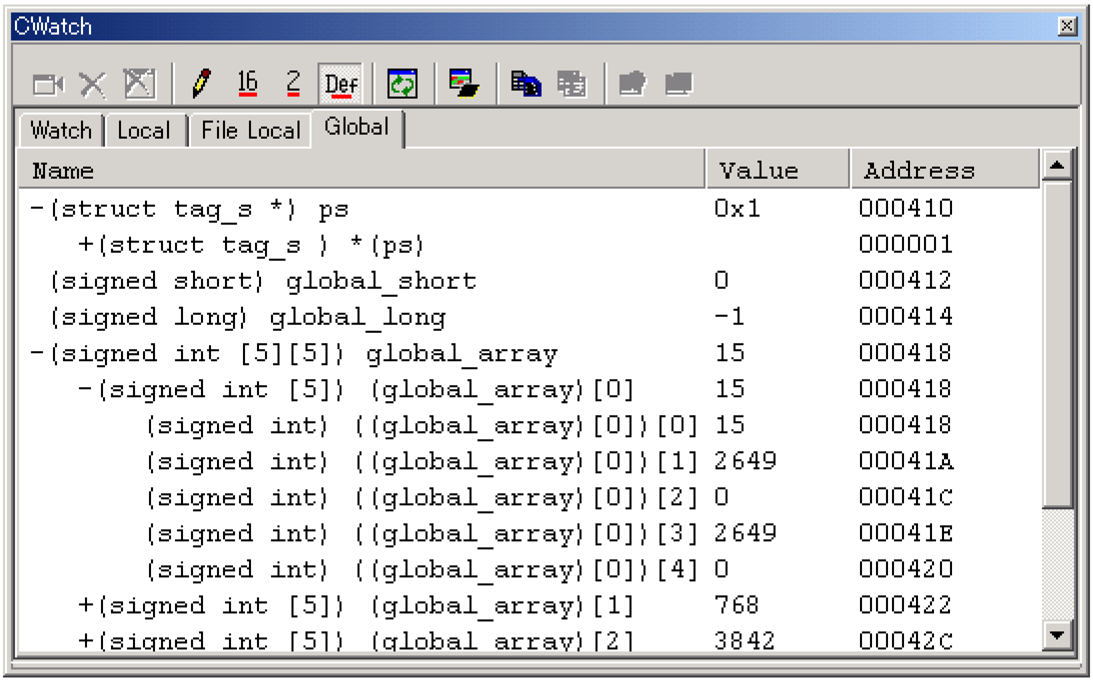
7.2.1 Extended Menus

This window has the following popup menus that can be brought up by right-clicking in the window.

Menu		Function
Add...		Add watchpoint.
Add Bit...		Add bit-lebel watchpoint.
Remove		Remove the selected watchpoint.
Remove All		Remove all watchpoints.
Set...		Set new data to selected watchpoint.
Radix	Bin	Display in Binary.
	Dec	Display in Decimal.
	Hex	Display in Hexadecimal.
Refresh		Refresh memory data.
Layout	Address Area	Switch display or non-display of Address area.
	Size Area	Switch display or non-display of Size area.
RAM Monitor	Enable RAM Monitor	Switch enable or disable RAM moniter function.
	Sampling Period...	Set RAM monitor sampling period.
Toolbar display		Display toolbar.
Customize toolbar...		Open toolbar customize dialog box.
Allow Docking		Allow window docking.
Hide		Hide window.

7.3 C Watch Window

The C Watch Window displays C/C++ expressions and their values (results of calculations).
The C/C++ expressions displayed in the C Watch Window are known as C watchpoints. The displays of the results of calculating the C watchpoints are updated each time a command is executed.
When RAM monitor function is effective and the C watch points are within the RAM monitor area, the displayed values are updated during execution of the target program.



Name	Value	Address
-(struct tag_s *) ps	0x1	000410
+(struct tag_s) *(ps)		000001
(signed short) global_short	0	000412
(signed long) global_long	-1	000414
-(signed int [5][5]) global_array	15	000418
-(signed int [5]) (global_array)[0]	15	000418
(signed int) ((global_array)[0])[0]	15	000418
(signed int) ((global_array)[0])[1]	2649	00041A
(signed int) ((global_array)[0])[2]	0	00041C
(signed int) ((global_array)[0])[3]	2649	00041E
(signed int) ((global_array)[0])[4]	0	000420
+(signed int [5]) (global_array)[1]	768	000422
+(signed int [5]) (global_array)[2]	3842	00042C

- Variables can be inspected by scope (local, file local or global).
- The display is automatically updated at the same time the PC value changes.
- Variable values can be changed.
- The display radix can be changed for each variable individually.

- The initial display radix can be changed.
- Leading-zero suppression is selectable in hexadecimal display.

- Any variable can be registered to the Watch tab, so that it will be displayed at all times:

- The registered content is saved for each project separately.
- If two or more of the C watch window are opened at the same time, the registered.
- The reference scope of the variable is selectable from current scope, global scope and each file's scopes.

- The C watchpoints can be registered to separate destinations by adding Watch tabs.
- Variables can be registered from another window or editor by a drag-and-drop operation.
- The C watchpoints can be sorted by name or by address.
- The RAM monitor can be allocated to the address of specified variable

ATTENTION

- You cannot change the values of the C watch points listed below:
  - Register variables
  - C watch point which does not indicate an address(invalid C watch point)
- If a C/C++ language expression cannot be calculated correctly (for example, when a C/C++ symbol has not been defined), it is registered as invalid C watch point.
  It is displayed as "--<not active>--". If that C/C++ language expression can be calculated correctly at the second time, it becomes an effective C watch point.
- The display settings of the Local, File Local and Global tabs are not saved. The contents of the Watch tab and those of newly added tabs are saved.
- The variables, which are changed in RAM monitor function, are global variables and file local variables only.
- The RAM monitor function of this debugger is realized with memory dump. Real-time capability is impaired when this function is used.
- The background color by the access attribute cannot be changed.

About more information for C variables, please refer to "12.1.3 Get or set C variables"

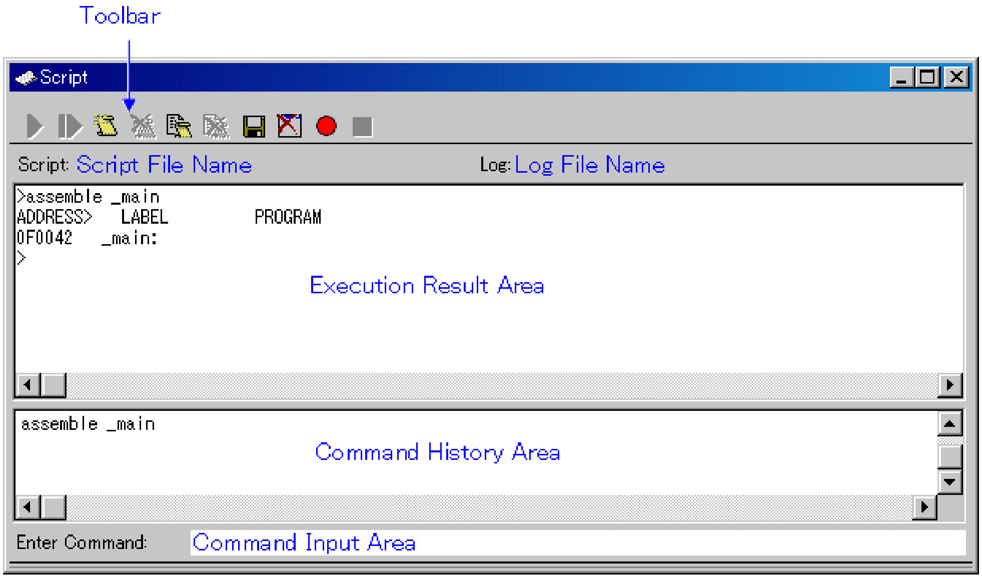
7.3.1 Extended Menus

This window has the following popup menus that can be brought up by right-clicking in the window.

Menu		Function
Add...		Add C watchpoint.
Remove		Remove the selected C watchpoint.
Remove All		Remove all C watchpoints.
Initialize		Reevaluates the selected C watchpoint.
Set New Value...		Set new data to selected C watchpoint.
Radix	Hex	Display in Hexadecimal.
	Bin	Display in Binary.
	Default	Display in Default Radix.
	Toggle(All Variables)	Change radix (toggle).
	Set initial...	Set initial radix.
Refresh		Refresh memory data.
Hide type name		Hide type names from variables.
Show char* as string		Selects whether to display char* type as a string.
Zero suppress in Hex display		Suppress zero in Hex display.
Sort	Sort by Name	Sort variables by its name.
	Sort by Address	Sort variables by its address.
RAM Monitor	Enable RAM Monitor	Switch enable or disable RAM monitor function.
	Sampling Period...	Set RAM monitor sampling period.
	Arrange a RAM monitor area around this variable	Arrange a RAM monitor area around this variable.
	Start Recording...	Start to record the updated values.
	Stop Recording	Stop recording the updated values.
Add New Tab...		Add new tab.
Remove Tab		Remove the selected tab.
Copy		Copy the selected item to the clipboard.
Copy All		Copy the all items in the sheet to the clipboard.
Toolbar display		Display toolbar.
Customize toolbar...		Open toolbar customize dialog box.
Allow Docking		Allow window docking.
Hide		Hide window.

7.4 Script Window

The Script Window displays the execution of text -format script commands and the results of that execution. Script commands can be executed using a script file or interactively. You can also write script commands in the script file so that they are automatically executed. The results of script command execution can also be stored in a previously specified log file.



```
>assemble _main
ADDRESS>   LABEL        PROGRAM
0F0042    _main:
>
```

```
assemble _main
```

- The Script Window has a view buffer that stores the results of executing the last 1000 lines. The results of execution can therefore be stored in a file (view file) without specifying a log file.
- When a script file is opened, the command history area changes to become the script file display area and displays the contents of the script file. When script files are nested, the contents of the last opened script file are displayed. The script file display area shows the line currently being executed in inverse vide.
- When a script file is open, you can invoke script commands from the command input area provided the script file is not being executed.
- The Script Window can record the history of the executed commands to a file. This function is not the same as the log function. This function records not the result but only the executed commands, so the saved files can be used as the script files.

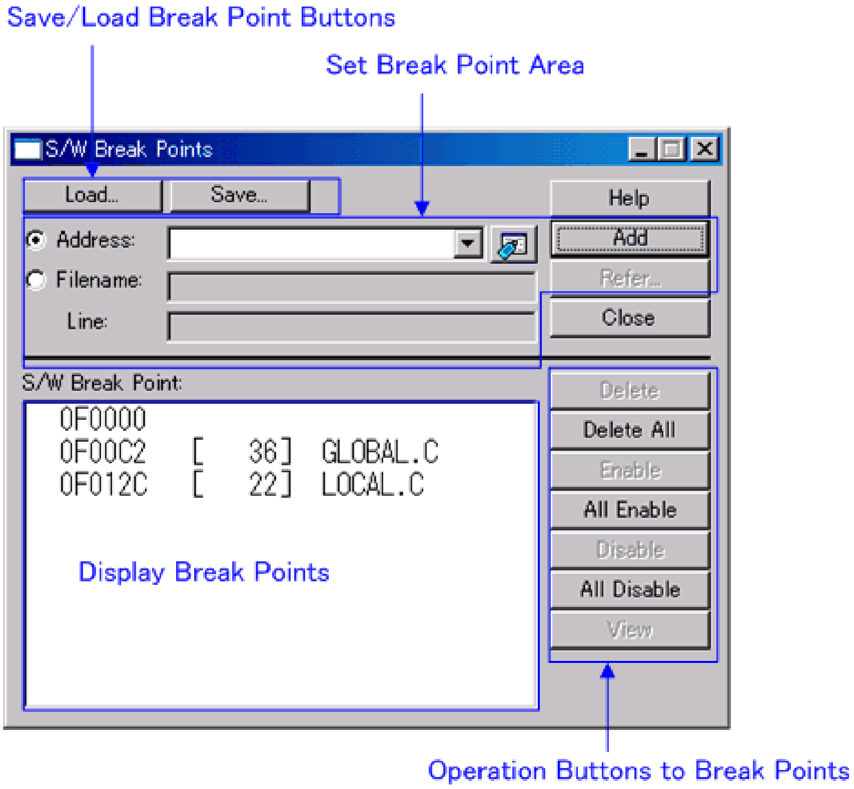
7.4.1 Extended Menus

This window has the following popup menus that can be brought up by right-clicking in the window.

Menu		Function
Script	Open...	Open script file.
	Run	Run script file.
	Step	One step execution of script file.
	Close	Close script file.
View	Save...	Save view buffer to file.
	Clear	Clear view buffer.
Log	On...	Open log file and start recording (start output to file).
	Off	Close log file and end recording (stop output to file).
Record	On...	Record the executed commands to a file.
	Off	Stop recording the executed commands.
Copy		Copy the selection and put it on the Clipboard.
Paste		Insert Clipboard contents.
Cut		Cut the selection and put it on the Clipboard.
Delete		Erase the selection.
Undo		Undo the last action.
Toolbar display		Display toolbar.
Customize toolbar...		Open toolbar customize dialog box.
Allow Docking		Allow window docking.
Hide		Hide window.

7.5 S/W Break Point Setting Window

The S/W Break Point Setting window allows you to set software break points.
Software breaks stop the execution of instructions immediately before the specified break point.



```
0F0000
0F00C2    [   36]  GLOBAL.C
0F012C    [   22]  LOCAL.C
```

- If you have set multiple software breakpoints, program execution stops when any one software break address is encountered (OR conditions).
- You can continue to set software breakpoints until you click the "Close" button to close the S/W Break Point Setting Window.
- You can clear, enable or disable software breakpoints selected by clicking in the software breakpoint display area. You can also enable and disable software breakpoints by double-clicking on them.
- Click on the "Save" button to save the software break points in the file. To reload software break point settings from the saved file, click the "Load" button. If you load software break points from a file, they are added to any existing break points.

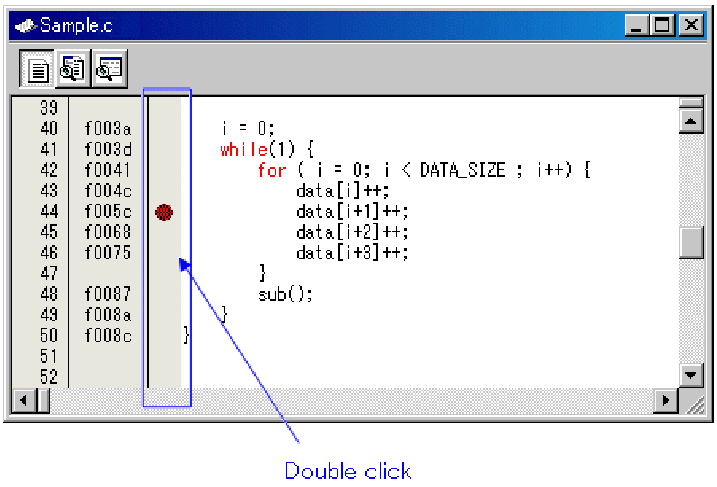
7.5.1 Command Button

The buttons on this window has the following meanings.

Button	Function
Load...	Load setting information from a file in which it was saved.
Save...	Save the contents set in the window to a file.
Help	Display the help of this window.
Add	Add the break point.
Refer...	Open file selection dialog box.
Close	Close the window.
Delete	Remove the selected break point.
Delete All	Remove all break points.
Enable	Enable the selected break points.
All Enable	Enable all break points.
Disable	Disable the selected break point.
All Disable	Disable all break points.
View	Shows the selected breakpoint positions in the Editor(Source) window.

7.5.2 Setting and Deleting a Break Points from Editor(Source) Window

The area which can be set in the software breakpoint is different according to the product. Please refer to "12.1.2 Area where software breakpoint can be set" for details.
You can set break points in the Editor(Source) Window. To do so, double-click the break point setting area ("S/W breakpoints" column) for the line in which you want to set the break. (A red marker is displayed on the line to which the break point was set.)



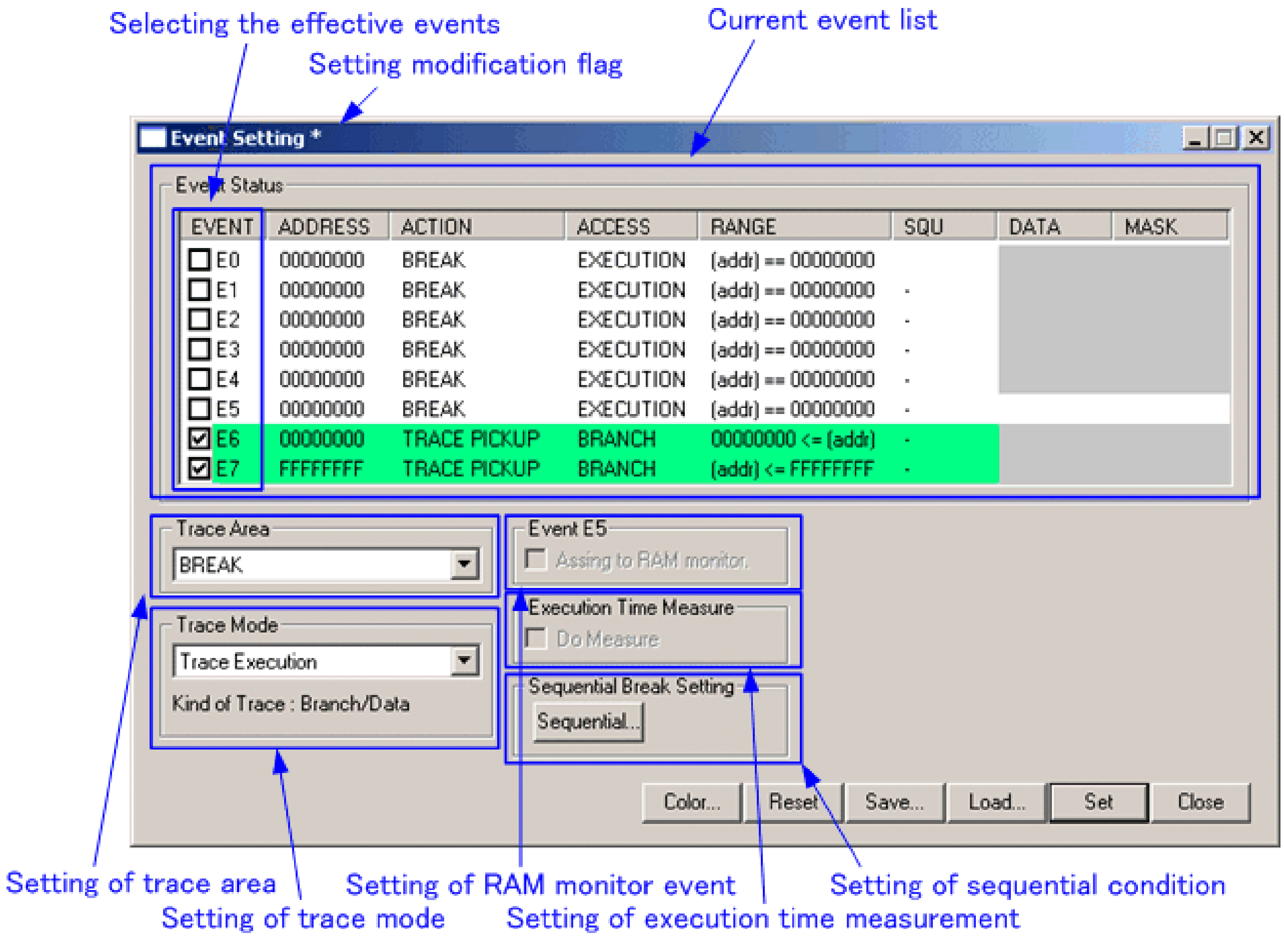
```
f003a        i = 0;
f003d        while(1) {
f0041            for ( i = 0; i < DATA_SIZE ; i++) {
f004c                data[i]++;
f005c   ●            data[i+1]++;
f0068                data[i+2]++;
f0075                data[i+3]++;
                 }
f0087            sub();
f008a        }
f008c    }
```

You can delete the break point by double-clicking again in the break point setting area ("S/W breakpoints" column).

In the Editor(Source) window, a display of "S/W breakpoints" column is set to "Enable" by default. To erase this column, deselect the [S/W breakpoints] check box in the dialog box opened by choosing the main menu - [Edit] -> [Define Column Format]. The "S/W breakpoints" column is erased from all Editor (Source) windows. And select popup menu - [Columns] -> [S/W breakpoints] in the Editor (Source) window, A column can be set up for each Editor (Source) windows.

7.6 Event Setting Window

The Event Setting window is used to set break events, trace events, time measurement events, and RAM monitor event.



EVENT	ADDRESS	ACTION	ACCESS	RANGE	SQU	DATA	MASK
□ E0	00000000	BREAK	EXECUTION	(addr) == 00000000			
□ E1	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E2	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E3	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E4	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E5	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
☑ E6	00000000	TRACE PICKUP	BRANCH	00000000 <= (addr)	-		
☑ E7	FFFFFFFF	TRACE PICKUP	BRANCH	(addr) <= FFFFFFFF	-		

Trace Area: BREAK

Trace Mode: Trace Execution

Kind of Trace : Branch/Data

- If the contents of events are altered, they are marked by an asterisk (*) on the title bar. The asterisks (*) are not displayed after setting up the emulator.
- A total of 8 events comprised of break events, trace events, and interval time measurement events can be used. The combinatorial conditions of events are as follows:

– Trace when one of the valid events is established. (OR condition)

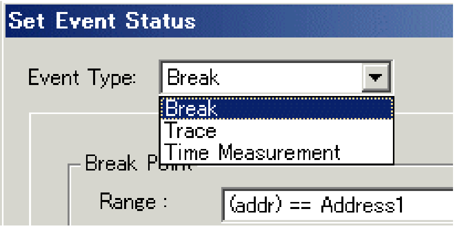
– Events occur in a specified order. (Sequential condition)

ATTENTION

- To change an already set event to another event, clear the currently set event in the EVENT area first before setting a new event.
- The combinatorial event condition of Sequential can be specified for only break events.

7.6.1 Specify the Event

To set events, double-click in the event setting area of the Event Setting Window. This opens an event setting dialog box.
The type of event you specify can be changed by altering Event Type in this dialog box.



Set Event Status

Event Type: Break

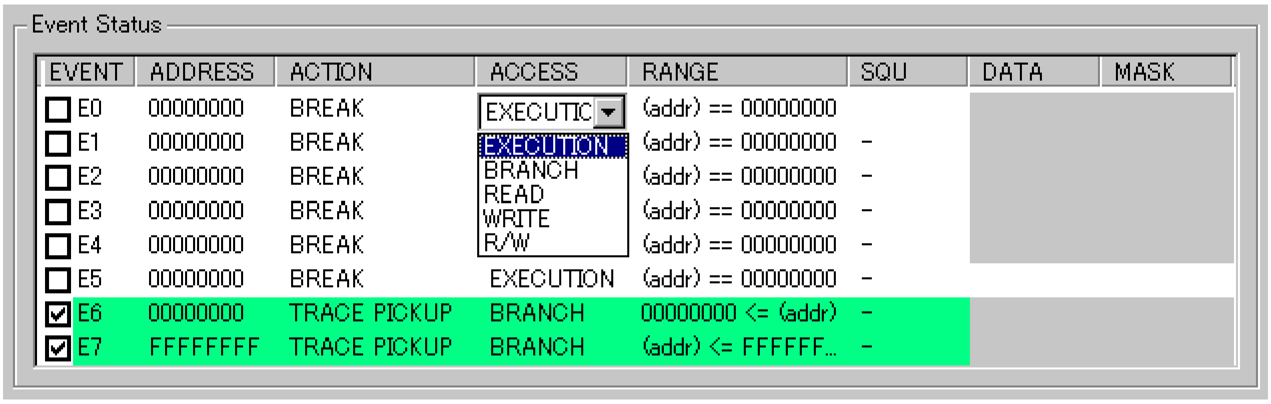
Break Point

Range : (addr) == Address1

If you set events in the Set Event Status dialog box, they will be set as unused events. Unused events are searched in the order shown below.

E7 -> E6 -> E3 -> E2 -> E1 -> E5 -> E4 -> E0
The events E0 and E4 and the event E5 are assigned lower priorities because the former are special events for specifying the trace or the start and end of time measurement, and the latter is a data comparison break event or the RAM monitor event.

You also can set events directly in the event setting area of the Event Setting Window. Select the line for the event you want to set and then click on a condition to select.



Event Status

EVENT	ADDRESS	ACTION	ACCESS	RANGE	SQU	DATA	MASK
☐ E0	00000000	BREAK	EXECUTIC	(addr) == 00000000			
☐ E1	00000000	BREAK		(addr) == 00000000	-		
☐ E2	00000000	BREAK		(addr) == 00000000	-		
☐ E3	00000000	BREAK		(addr) == 00000000	-		
☐ E4	00000000	BREAK		(addr) == 00000000	-		
☐ E5	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
☑ E6	00000000	TRACE PICKUP	BRANCH	00000000 <= (addr)	-		
☑ E7	FFFFFFFF	TRACE PICKUP	BRANCH	(addr) <= FFFFFF...	-		

The following can be set up as a condition of each event.

7.6.1.1 Select the access condition

Select the access condition for an event to occur. Use the ACCESS area of the Event Setting Window to make this selection.

ACCESS Condition	Content
EXECUTION	Instruction Execution
BRANCH	Branch
READ	Data Read
WRITE	Data Write
R/W	Data Read or Data Write

The ACCESS conditions that can be specified for each event are listed below.

Event	ACCESS Condition				
	EXECUTION	BRANCH	READ	WRITE	R/W
Break event	Yes	No	Yes	Yes	Yes
Trace event(Trace pickup event)	No	Yes	Yes	Yes	Yes
Trace event(Trace start event and Trace end event)	Yes	No	Yes	Yes	Yes
Interval time measurement event	No	No	Yes	Yes	Yes
RAM monitor event	No	No	No	No	No

7.6.1.2 Select address match or range specification

Select address match or range specification as the address range condition for an event to occur. Use the RANGE area of the Event Setting Window to make this selection.

RANGE Condition	Content
EQU	Address match
IN(START)	Address range specification (Start Address)
IN(END)	Address range specification (End Address)

Address range specification cannot be set for the events that have had EXECUTION selected in ACCESS condition. Note also that only the following combinations of events can be selected.

- E0(Start Address) and E1(End Address)
- E2(Start Address) and E3(End Address)
- E4(Start Address) and E5(End Address)
- E6(Start Address) and E7(End Address)

7.6.2 Select the action condition by which an event is assumed to have occurred

Select the action condition by which an event is assumed to have occurred. Use the ACTION area of the Event Setting Window to make this selection.
Any event selected in the EVENT area is displayed in different colors depending on the event action you have selected for it in the ACTION area. The display color can be changed using the Color button.

ACTION Condition	Content	Color
BREAK	Break	Red
TRACE PICKUP	Trace Pickup	Green
TIME START	Execution time measuring start	Yellow
TIME END	Execution time measuring end	Yellow
TIME	Interval time measurement	Orange
TRACE START	Tracing start	Blue
TRACE END	Tracing end	Blue
RAM MONITOR	RAM monitor function use	Purple

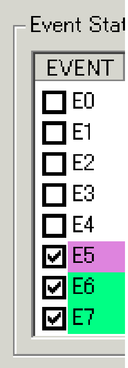
The ACTION conditions that can be specified for each event are listed below.

Event	ACTION Condition							
	BREAK	TRACE PICKUP	TIME START	TIME END	TIME	TRACE START	TRACE END	RAM MONITOR
Event E0	Yes	Yes	Yes	No	No	Yes	No	No
Event E1	Yes	Yes	No	No	Yes	No	No	No
Event E2	Yes	Yes	No	No	Yes	No	No	No
Event E3	Yes	Yes	No	No	Yes	No	No	No
Event E4	Yes	Yes	No	Yes	No	No	Yes	No
Event E5	Yes	Yes	No	No	Yes	No	No	Yes
Event E6	Yes	Yes	No	No	Yes	No	No	No
Event E7	Yes	Yes	No	No	Yes	No	No	No

7.6.3 Select the Combinatorial Condition

Select the combinatorial conditions of an event. Use the EVENT and the SEQ areas of the Event Setting Window to make this selection.

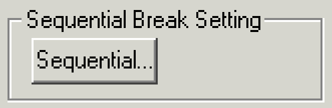
- Select the OR Condition In the EVENT area you can select an use event.



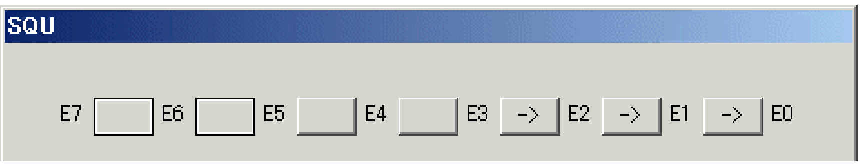
- Select the Sequential Condition In the SEQ area you can select an event for which the Sequential condition is to be set. Sequential condition can only be selected for break events. However, if the event E5 is used to set a data comparison break event or the RAM monitor event, you cannot specify Sequential for the event E5.

Sequential Condition	Content
-	Single Condition
Ex -> Ex-1	Sequential Condition

The Sequential condition can also be selected using the Sequential button.



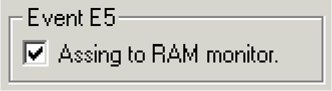
Click on the button between the events for which you want to specify the Sequential condition. Transition between the events will be shown by an arrow. The Sequential condition can only be specified for the events that have been set as break events. Example: To set successively occurring events as in E3 -> E2 -> E1 -> E0



The Sequential condition can be specified for two to eight events. You also can specify multiple Sequential conditions in pairs. If the Sequential condition is specified for the event En, that event and the event En-1 are specified to be Sequential. The Sequential condition can be specified in order of events En, En-1, En-2, and so on. For example, the Sequential condition can be specified for events E2 -> E1 -> E0, but cannot be specified in order of E0 -> E1 -> E2, or in order of E3 -> E0, etc.

7.6.4 Setting the RAM monitor event

To set the RAM monitor event, select the below check box.



Event E5

☑ Assing to RAM monitor.

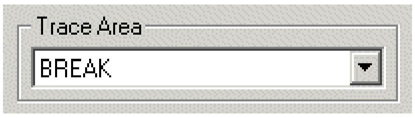
The RAM monitor event is set to the event E5.
Please note that the RAM monitor function doesn't operate when the RAM monitor event is not set.

ATTENTION

- Only when RAM monitor mode is selected in the Debugging Mode tab of the Init dialog, RAM monitor function can be used.

7.6.5 Select the Trace Range

A trace range can be selected for the trace event concerned.
A trace measurement of up to 8M cycles can be recorded.



Trace Area

BREAK

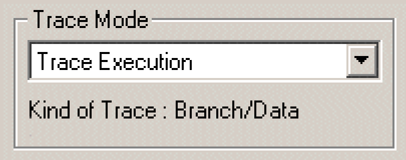
Trace Area	Content
Break	Stores the 8M cycles to the point at which the target program stops.
Before	Stores the 8M cycles to the point at which the trace point is passed.
After	Stores the 8M cycles of trace data after the trace point.
Full	Stores the 8M cycles of trace data after the trace starts.

ATTENTION

- Only when Trace mode is selected in the Debugging Mode tab of the Init dialog, Trace function can be used.

7.6.6 Select the Trace Mode

The trace mode can be selected.



Trace Mode

Trace Execution

Kind of Trace : Branch/Data

Mode	Content
Trace priority	The Trace priority mode gives priority to the trace data output, and the MCU execution is delayed.
MCU execution priority	The MCU execution priority mode gives priority to the MCU execution, and the trace range is 512 cycles.

The kind of trace data to record is displayed in the trace kind column.

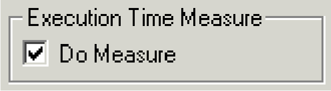
Kind	Content
Branch/Data	Branch trace, Data trace
Branch(Compression)	Condition branch trace

ATTENTION

- Only when Trace mode is selected in the Debugging Mode tab of the Init dialog, Trace function can be used.

7.6.7 Setting the execution time measurement

The trace mode can be selected.



Execution Time Measure

☑ Do Measure

The Execution time measurement event is set to the event E0 and the event E4.
Please note that the execution time measurement function doesn't operate when the Execution time measurement event is not set.

ATTENTION

- Only when Time measurement mode is selected in the Debugging Mode tab of the Init dialog, Execution time measurement function can be used.

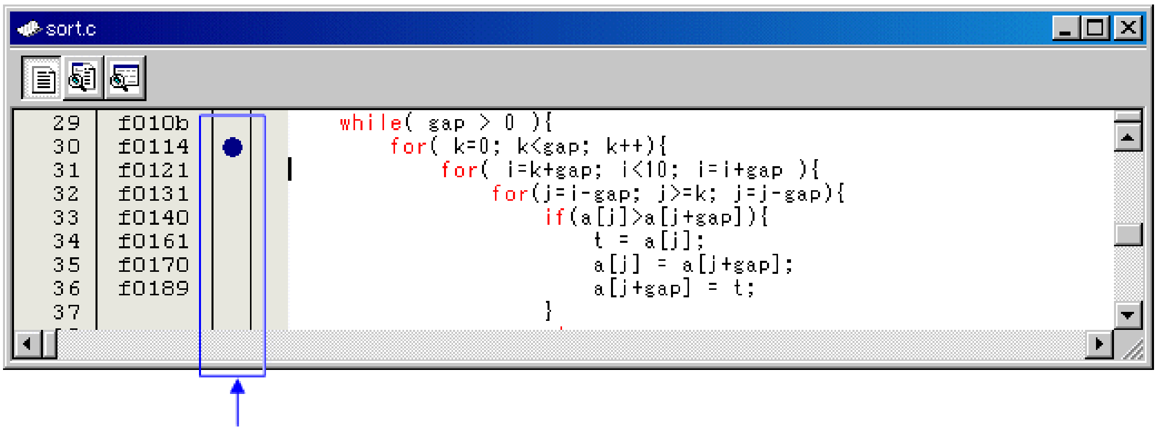
7.6.8 Command Button

The buttons at the bottom of the Event Setting window have the following meanings.

Button Name	Content
Color...	Change the display color of the event list.
Reset	Discards the contents being displayed in the window and loads contents from the emulator in which they were set.
Save...	Saves the contents set in the window to a file.
Load...	Loads event information from a file in which it was saved.
Set	Sends the contents set in the window to the emulator.
Close	Closes the window.

7.6.9 Setting and Deleting a Break Points from Editor(Source) Window

You can set break points in the Editor(Source) Window. To do so, double-click the break point setting area ("H/W Breakpoints" column) for the line in which you want to set the break. (A blue marker is displayed on the line to which the break point was set.)



```
f010b       while( gap > 0 ){
f0114   ●       for( k=0; k<gap; k++){
f0121               for( i=k+gap; i<10; i=i+gap ){
f0131                   for(j=i-gap; j>=k; j=j-gap){
f0140                       if(a[j]>a[j+gap]){
f0161                           t = a[j];
f0170                           a[j] = a[j+gap];
f0189                           a[j+gap] = t;
                            }
```

Double click.

You can delete the break point by double-clicking again in the break point setting area ("H/W Breakpoints" column).

In the Editor(Source) window, a display of "H/W Breakpoints" column is set to "Enable" by default. To erase this column, deselect the [H/W Breakpoints] check box in the dialog box opened by choosing the main menu - [Edit] -> [Define Column Format]. The "H/W Breakpoints" column is erased from all Editor (Source) windows. And select popup menu - [Columns] -> [H/W Breakpoints] in the Editor (Source) window, A column can be set up for each Editor (Source) windows.

7.6.10 Specify the Break Events

To specify an break event, select Break on the Event Type of the Event Select dialog box.

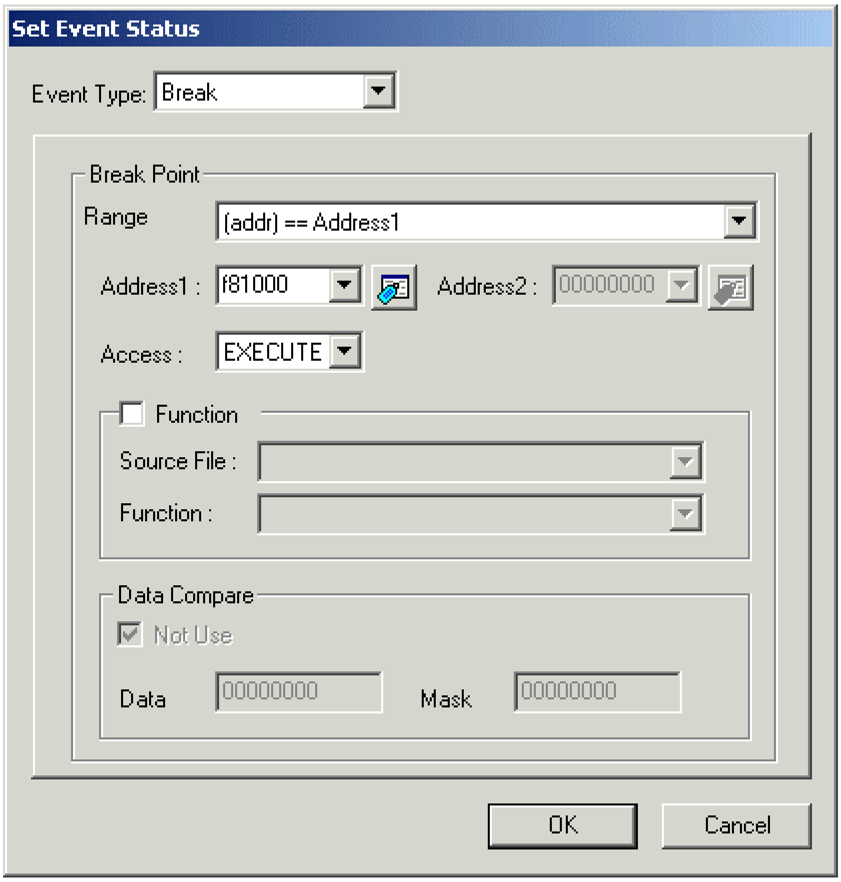
Following events can be set for an break event.

- Instruction Execution
  To specify an instruction execution event, select the "EXECUTION" in the ACCESS area of the event. The event is established immediately before executing the instruction at a specified address.
- Memory Access
  To specify a memory access event, select the "READ" or "WRITE or "R/W" in the ACCESS area of the event. The event is established when memory is accessed at the specified address or under conditions set for the specified address range. When specifying a break event for memory access, you can specify the data to be compared with the data written/read to or from a specified address. You also can specify mask bits for the comparison data.

7.6.10.1 Instruction Execution of Specified Address

Specify the following.

Example) Instruction execution at address F81000h



Set Event Status

Event Type: Break

Break Point

Range (addr) == Address1

Address1 : f81000

Address2 : 00000000

Access : EXECUTE

□ Function

Source File :

Function :

Data Compare

☑ Not Use

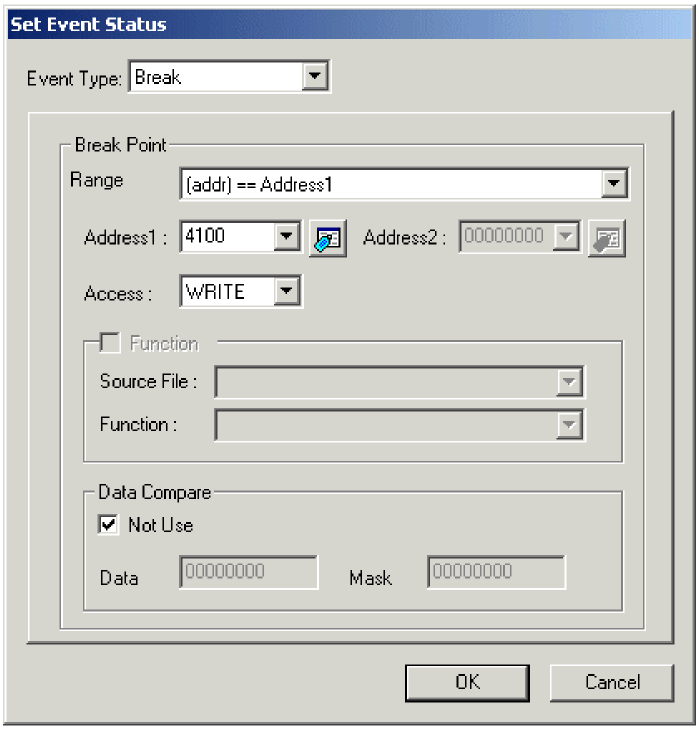
Data 00000000

Mask 00000000

7.6.10.2 Writing/Reading a Specified Address

Set as below.

Example) Writing to address 4100h



Set Event Status

Event Type: Break

Break Point

Range: (addr) == Address1

Address1 : 4100

Address2 : 00000000

Access : WRITE

□ Function

Source File :

Function :

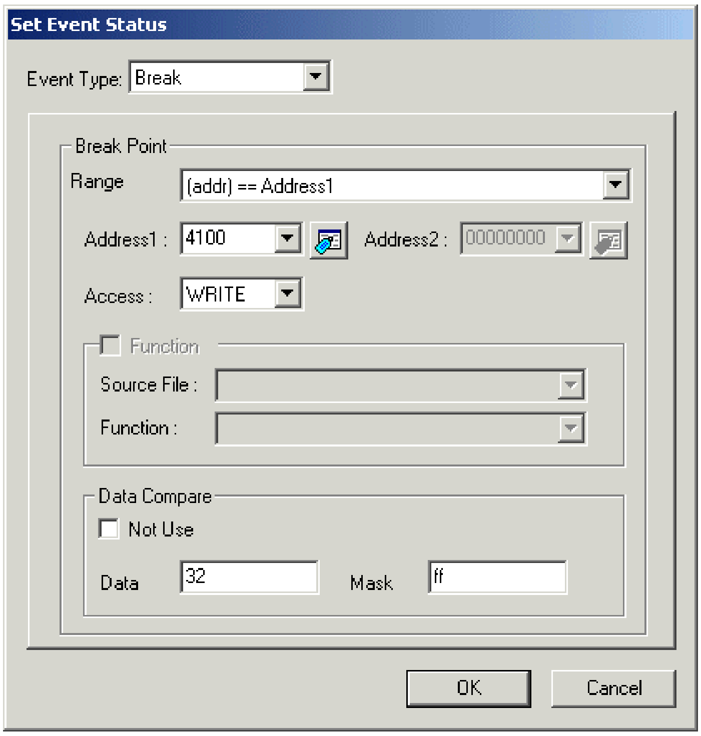
Data Compare

☑ Not Use

Data: 00000000

Mask: 00000000

Example) Writing byte length data 32h to address 4100h



Set Event Status

Event Type: Break

Break Point

Range: (addr) == Address1

Address1 : 4100

Address2 : 00000000

Access : WRITE

□ Function

Source File :

Function :

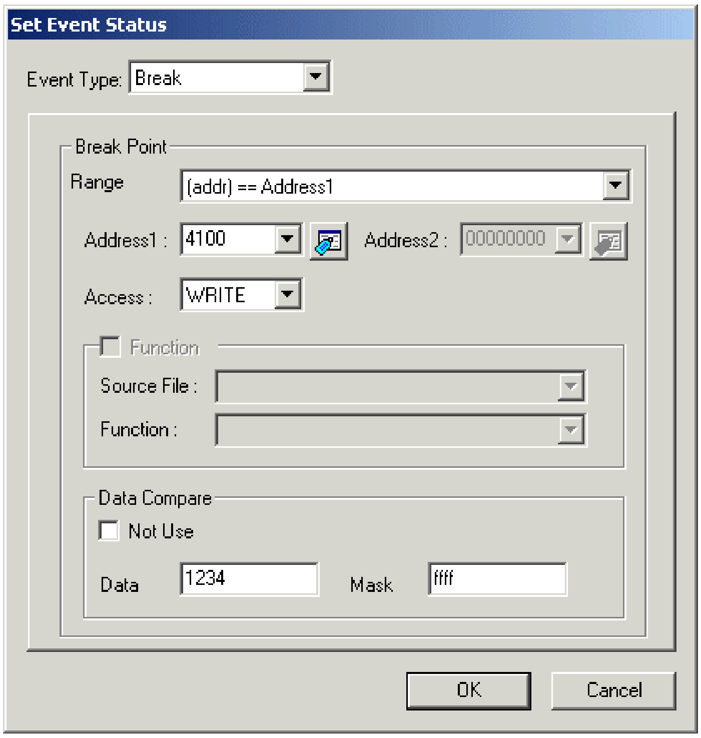
Data Compare

□ Not Use

Data: 32

Mask: ff

Example) Writing word length data 1234h to address 4100h



Event Type: Break

Range: (addr) == Address1

Address1 : 4100

Address2 : 00000000

Access : WRITE

□ Function

Source File :

Function :

□ Not Use

Data: 1234

Mask: ffff

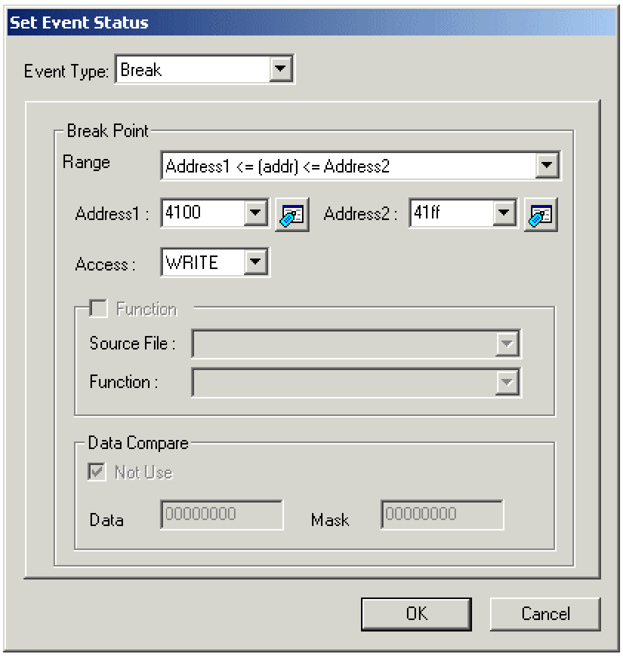
ATTENTION

- Data comparison can be specified for the event E5 only when Trace mode is selected in the Debugging Mode tab of the Init dialog.
- If the event E5 is used for a break event without data comparison, be sure to specify 0000h for the mask value. Furthermore, if it is used for data comparison in byte units, specify 00FFh for the mask value. Note that data comparison in word units beginning with an odd address can also be specified.
- If data comparison is set, the real-time capability of the user program execution will be lost.

7.6.10.3 Reading/writing data to the specified address range

Set as below.

Example) Writing data to addresses ranging from 4100h to 41FFh


Set Event Status

Event Type: Break

Break Point

Range: Address1 <= (addr) <= Address2

Address1 : 4100 Address2 : 41ff

Access : WRITE

□ Function

Source File :

Function :

Data Compare

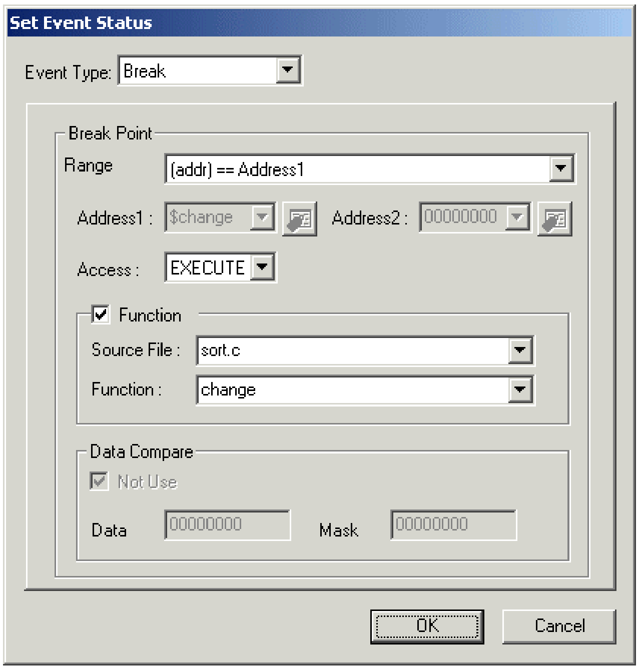
☑ Not Use

Data 00000000 Mask 00000000

7.6.10.4 Entering to specified function

Set as below.

Example) Entering a break to function name “change”


Set Event Status

Event Type: Break

Break Point

Range: (addr) == Address1

Address1 : $change Address2 : 00000000

Access : EXECUTE

☑ Function

Source File : sort.c

Function : change

Data Compare

☑ Not Use

Data 00000000 Mask 00000000

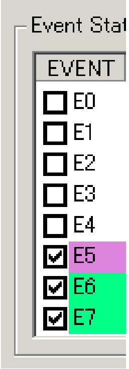
7.6.11 Specify the Event Combination Condition

Break events can be used in one of the following combinations. (A total of 8 events comprised of break events, trace events, and time measurement events in combination can be specified.)

- One of the specified events is established. (OR condition)
- Events occur in a specified order. (Sequential condition)

7.6.11.1 Select OR

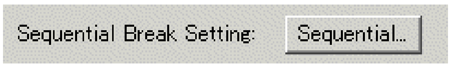
Check (turn on) an event in the event specification area that you want to use.



□ E0
□ E1
□ E2
□ E3
□ E4
☑ E5
☑ E6
☑ E7

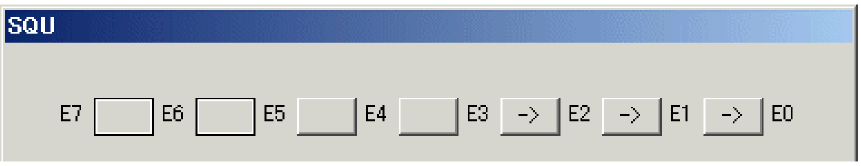
7.6.11.2 Select Sequential

Use the Seaquential button.

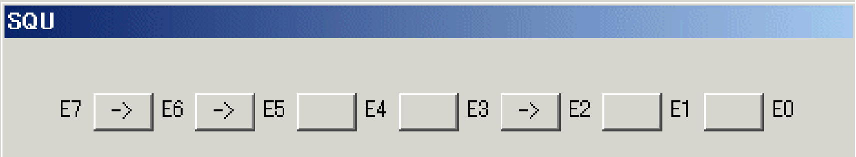


Click on the button between the events for which you want to specify the Sequential condition. Transition between the events will be shown by an arrow. The Sequential condition can only be specified for the events that have been set as break events. However, if the event E5 is used to set a data comparison break event, you cannot specify Sequential for the event E5.
The Sequential condition can be specified for two to eight events. You also can specify multiple Sequential conditions in pairs.
If the Sequential condition is specified for the event En, that event and the event En-1 are specified to be Sequential.
The Sequential condition can be specified in order of events En, En-1, En-2, and so on. For example, the Sequential condition can be specified for events E2 -> E1 -> E0, but cannot be specified in order of E0 -> E1 -> E2, or in order of E3 -> E0, etc.

Example: To set successively occurring events as in E3 -> E2 -> E1 -> E0



Example: To set successively occurring events as in E3 -> E2 and E7 -> E6 -> E5


SQU

E7 -> E6 -> E5 E4 E3 -> E2 E1 E0

7.6.12 Specify the Trace Events

To specify a trace event, select Trace Point on the Trace/Time Measurement tab of the Event Select dialog box.

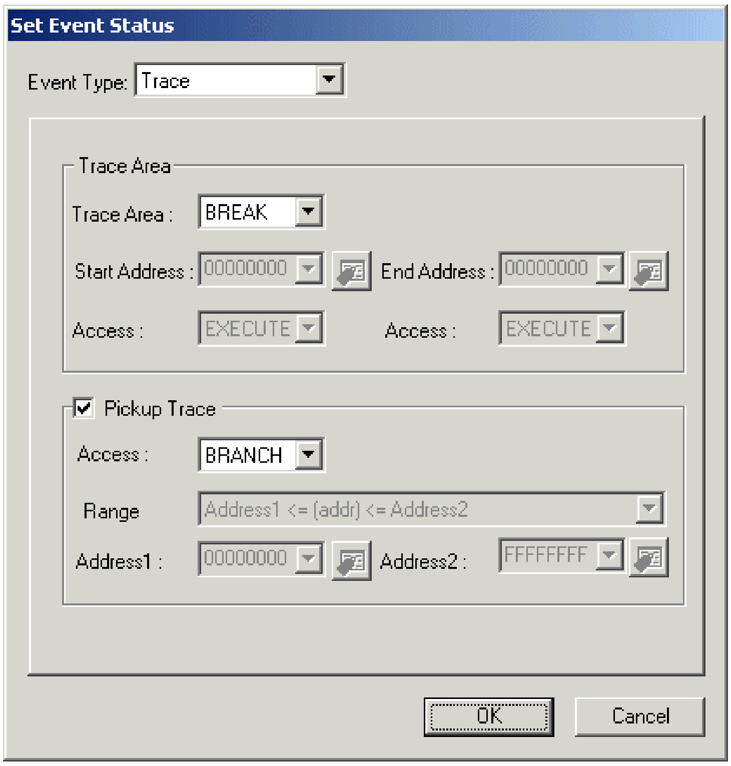
For the trace event, you can specify a branch trace event that records jump address information or a data trace event that records data access information. For whichever trace event to be set, you should specify trace conditions as necessary.
Note that you can set both branch trace event and data trace event, so that mixed information can be recorded.
When the trace event are not set, the trace function is the condition branch trace. The condition branch trace is recorded by compressing information of the condition branch instruction.
Therefore, the condition branch trace can record the execution history more than the branch trace.

The following shows the trace conditions that can be set.

- Specify the branch trace event

The new instruction address fetched at the jump address is recorded.
To specify an branch trace event, select the "BRANCH" in the ACCESS area of the event. The branch trace event can specify only the setting that records jump address information in the entire address range.
Specify the following.

Example: To record the jump address information in the entire address range


Set Event Status

Event Type: Trace

Trace Area

Trace Area : BREAK

Start Address : 00000000 End Address : 00000000

Access : EXECUTE Access : EXECUTE

☑ Pickup Trace

Access : BRANCH

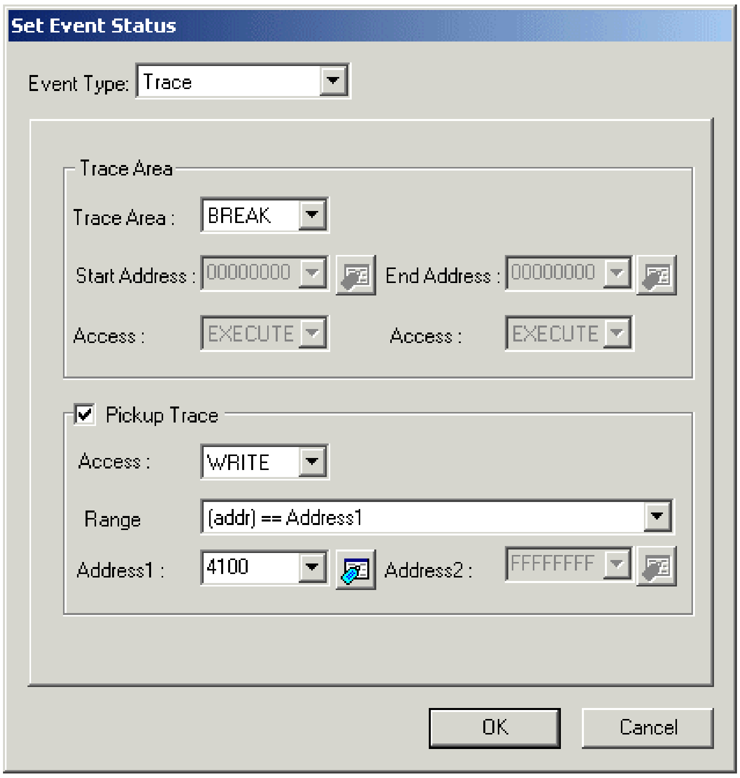
Range Address1 <= (addr) <= Address2

Address1 : 00000000 Address2 : FFFFFFFF

- **Specify the data trace event**

The access information to the specified address is recorded. To specify an data trace event, select the "READ/WRITE/RW" in the ACCESS area of the event. The event is established when memory is accessed at the specified address or under conditions set for the specified address range.
Specify the following.

Example: To record the data writes to the address 4100h



Event Type: Trace

Trace Area

Trace Area : BREAK

Start Address : 00000000 End Address : 00000000

Access : EXECUTE Access : EXECUTE

☑ Pickup Trace

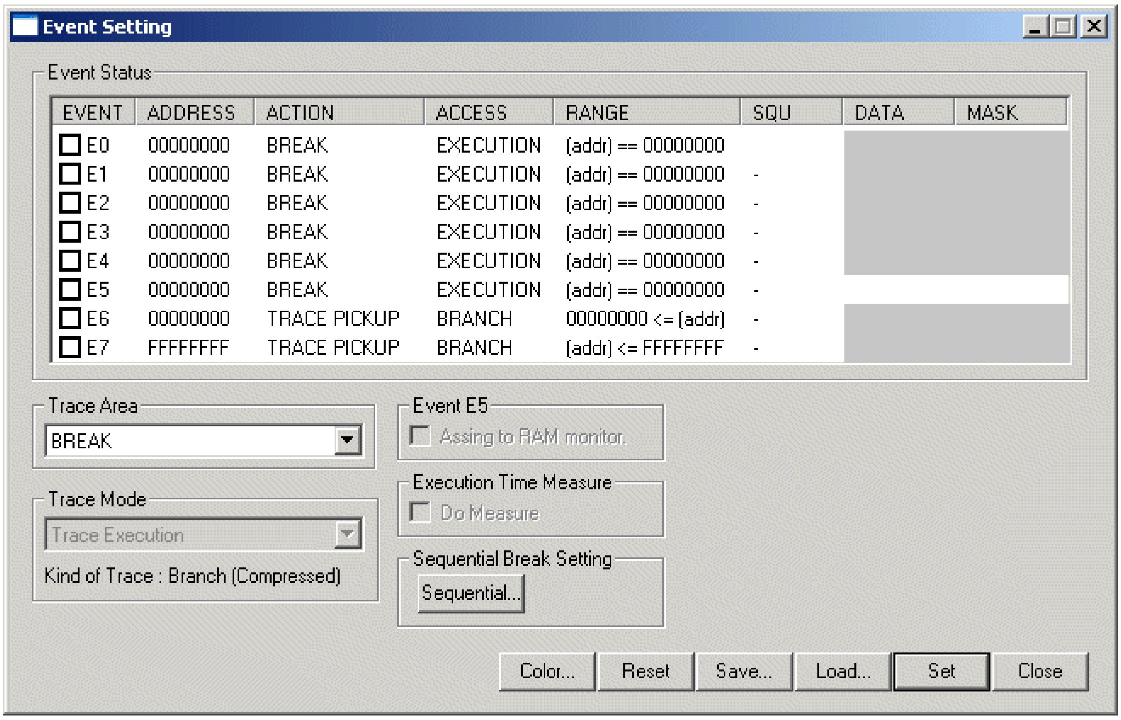
Access : WRITE

Range (addr) == Address1

Address1 : 4100 Address2 : FFFFFFFF

- Specify the condition branch trace

The jump address information in the entire address range is recorded.
Please remove all the trace events.



Event Status

EVENT	ADDRESS	ACTION	ACCESS	RANGE	SQU	DATA	MASK
□ E0	00000000	BREAK	EXECUTION	(addr) == 00000000			
□ E1	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E2	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E3	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E4	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E5	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E6	00000000	TRACE PICKUP	BRANCH	00000000 <= (addr)	-		
□ E7	FFFFFFFF	TRACE PICKUP	BRANCH	(addr) <= FFFFFFFF	-		

Trace Area: BREAK

Trace Mode: Trace Execution

Kind of Trace : Branch (Compressed)

Event E5: □ Assing to RAM monitor.

Execution Time Measure: □ Do Measure

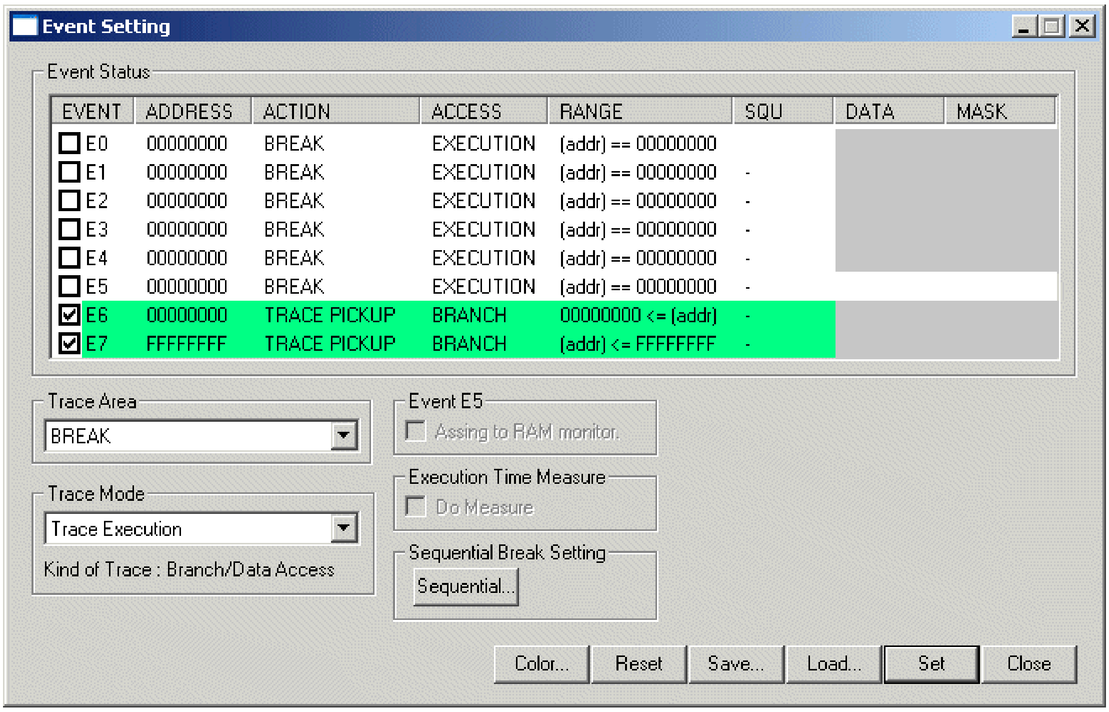
Sequential Break Setting: Sequential...

7.6.12.1 Specifying a trace range for the trace event to be set

To set a trace event, you need to specify a trace range. Event setting conditions differ depending on mode specified for a trace range.
The specifiable trace range and event setting conditions are shown below.

- **Specify Break or Full for the trace range for the trace event to be set**
  Specify any address or address range as you set a trace event. By default, Break is set for the trace range, and events for recording jump address information in the entire address range are set in E6 and E7 as the trace event.

  Default setting



EVENT	ADDRESS	ACTION	ACCESS	RANGE	SQU	DATA	MASK
□ E0	00000000	BREAK	EXECUTION	(addr) == 00000000			
□ E1	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E2	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E3	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E4	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E5	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
☑ E6	00000000	TRACE PICKUP	BRANCH	00000000 <= (addr)	-		
☑ E7	FFFFFFFF	TRACE PICKUP	BRANCH	(addr) <= FFFFFFFF	-		

Trace Area: BREAK

Trace Mode: Trace Execution

Kind of Trace : Branch/Data Access

Event E5: □ Assing to RAM monitor.

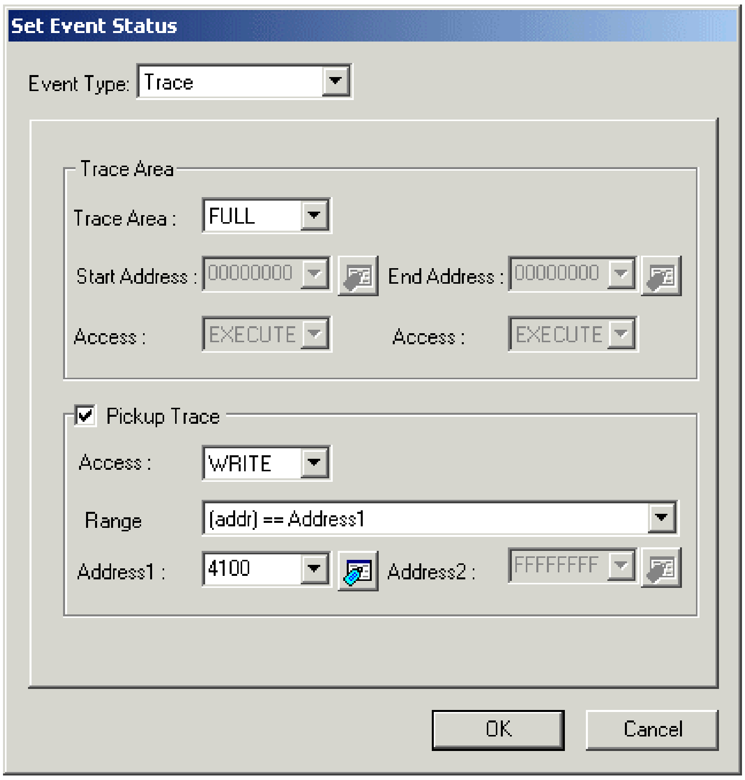
Execution Time Measure: □ Do Measure

Trace conditions (branch trace/data trace) should be specified in the ACCESS area of the event used. To specify an address range, use range specification of the event. The following shows a combination of events for which a range can be specified.

- Combination of E0 and E1
- Combination of E2 and E3
- Combination of E4 and E5
- Combination of E6 and E7

To perform a trace with any condition you specified, change the above setting.
Specify the following.

Example: To record data writes to the 4100h, 4110h and 4120h in Full mode



Event Type: Trace

Trace Area

Trace Area : FULL

Start Address : 00000000 End Address : 00000000

Access : EXECUTE Access : EXECUTE

☑ Pickup Trace

Access : WRITE

Range (addr) == Address1

Address1 : 4100 Address2 : FFFFFFFF

To set a data write to the addresses 4110h and 4120h, open the Set Event Status dialog box again and change the address in the Address1 text box shown above to register it as addition.

- Specify Before for the trace range for the trace event to be set
  Set the trace start event (only event E0 specifiable) and the trace end event (only event E4 specifiable) and then specify any address or address range to set a trace event.

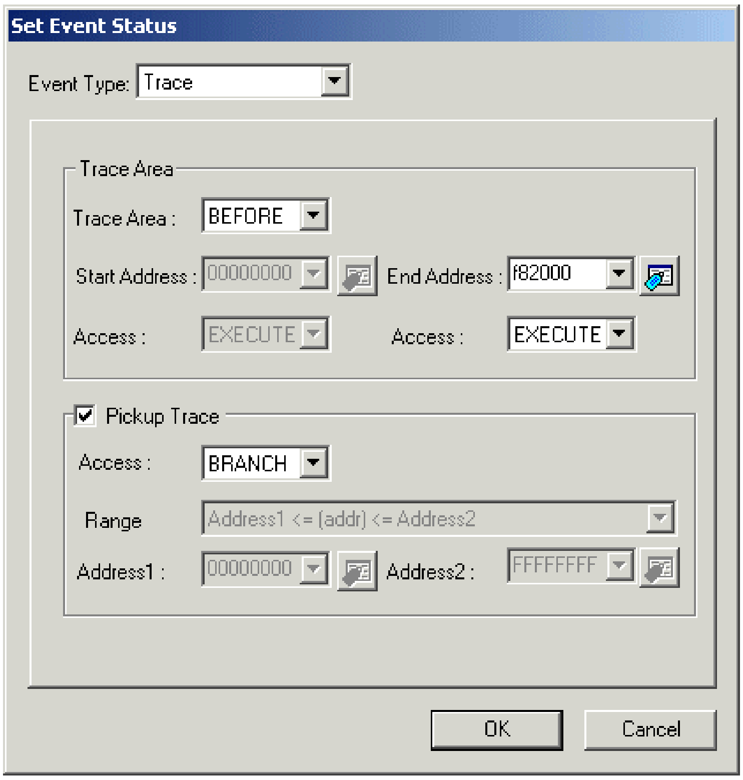
  In Before mode, the debugger records the trace events that have occurred from the trace start event (program started running) till the condition for the trace end event is met.

  For the trace start event, set a trace start for Before mode (by specifying the current PC value for the address and EXECUTION for the ACCESS condition) in the event E0. For the trace end event, set any address and ACCESS condition in the event E4 as the trace end condition.

  Trace conditions (branch trace/data trace) should be specified in the ACCESS area of the event used. To specify an address range, use range specification of the event. The events that can be combined in range specification are limited to those given below because the events E0 and E4 are used for the trace start and trace end events.
  - Combination of E2 and E3
  - Combination of E6 and E7

  By default, events for recording jump address information in the entire address range are set in E6 and E7 as the trace event.
  Specify the following.

  Example: To record jump address information in the entire address range in Before mode and specify instruction execution at the address F82000h as the trace end condition



Event Type: Trace

Trace Area

Trace Area : BEFORE

Start Address : 00000000

End Address : f82000

Access : EXECUTE

Access : EXECUTE

☑ Pickup Trace

Access : BRANCH

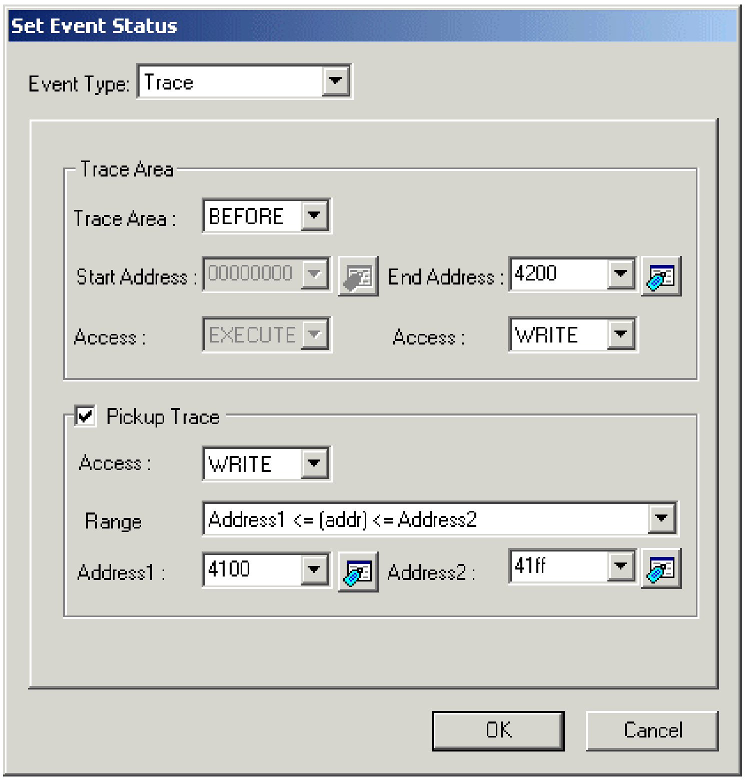
Range Address1 <= (addr) <= Address2

Address1 : 00000000

Address2 : FFFFFFFF

To perform a trace with any condition you specified, change the above setting.
Specify the following.

Example: To record data writes in the range 4100h to 41FFh in Before mode and specify data writes at the address 4200h as the trace end condition



Set Event Status

Event Type: Trace

Trace Area

Trace Area : BEFORE

Start Address : 00000000

End Address : 4200

Access : EXECUTE

Access : WRITE

☑ Pickup Trace

Access : WRITE

Range Address1 <= (addr) <= Address2

Address1 : 4100

Address2 : 41ff

- Specify After for the trace range for the trace event to be set

  Set the trace start event (only event E0 specifiable) and the trace end event (only event E4 specifiable) and then specify any address or address range to set a trace event.

  In After mode, the debugger records the trace events that have occurred from when the condition for the trace start event was met till when the program has stopped running.

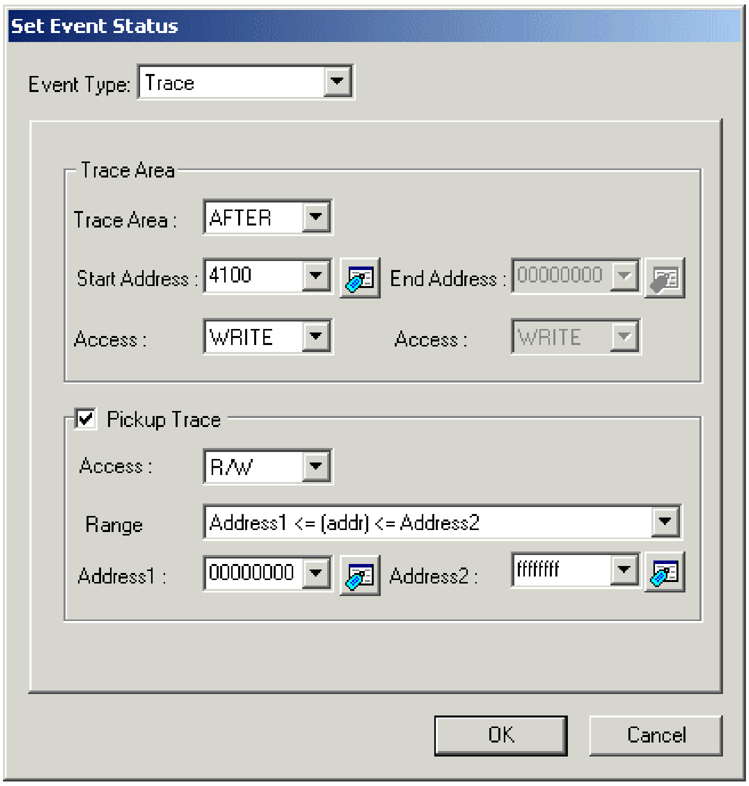
  For the trace start event, set any address and ACCESS condition in the event E0 as the trace start condition. For the trace end event, set a condition unlikely to occur (e.g., 0h is specified for the address while WRITE is specified for the ACCESS condition) in the event E4 as the trace end event for After mode.

  Trace conditions (branch trace/data trace) should be specified in the ACCESS area of the event used. To specify an address range, use range specification of the event. The events that can be combined in range specification are limited to those given below because the events E0 and E4 are used for the trace start and trace end events.

  - Combination of E2 and E3
  - Combination of E6 and E7

  By default, events for recording jump address information in the entire address range are set in E6 and E7 as the trace event.
  Specify the following.

  Example: To record data access (data read and data write) in the entire address range in After mode and specify data writes at the address 4100h as the trace start condition



Set Event Status

Event Type: Trace

Trace Area

Trace Area : AFTER

Start Address : 4100

End Address : 00000000

Access : WRITE

Access : WRITE

☑ Pickup Trace

Access : R/W

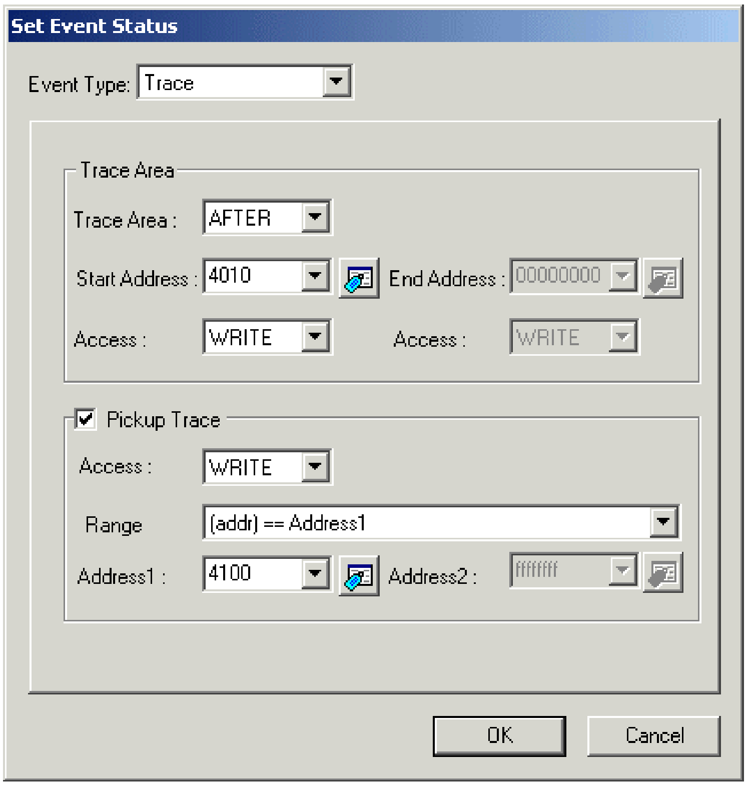
Range Address1 <= (addr) <= Address2

Address1 : 00000000

Address2 : ffffffff

To perform a trace with any condition you specified, change the above setting. Specify the following.

Example: To record data writes to the 4100h, 4110h and 4120h in After mode and and specify data writes at the address 4010h as the trace start condition



Event Type: Trace

Trace Area

Trace Area : AFTER

Start Address : 4010

End Address : 00000000

Access : WRITE

Access : WRITE

☑ Pickup Trace

Access : WRITE

Range (addr) == Address1

Address1 : 4100

Address2 : ffffffff

To set a data write to the addresses 4110h and 4120h, open the Set Event Status dialog box again and change the address in the Address1 text box shown above to register it as addition.

ATTENTION

- In Before and After modes, the debugger records the trace events that have occurred within the trace range, as well as the trace start events that occurred during that time. Note that no trace end events are recorded.
- The condition branch trace might take time to display the disassemble mode and the source mode of the trace window.
- When the MCU execution priority mode is selected in the trace mode, the trace range is 512 cycles. Please select the Trace priority mode in the trace mode when the trace range is 8M cycles. The Trace priority mode gives priority to the trace data output, and the MCU execution is delayed. This mode requires a program processing time more than in MCU execution priority mode. When the condition branch trace, the trace mode is the Trace priority mode.
- Only when Trace mode is selected in the Debugging Mode tab of the Init dialog, Trace function can be used.

7.6.13 Specify the Time Measurement Events

To specify an time measurement event, double-click to the event setting area. This opens an event setting dialog box. Select Time Measurement on the Event Type of the event setting dialog box.

There are the following measurement functions in the time measurement.

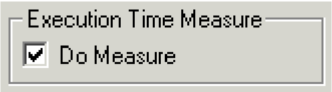
- Execution time measurement
  Measuring the program execution time from when the program started to when it stops.

- Interval time measurement
  Measuring the interval time from Start Event to End Event.
  Following events can be set for an interval time measurement event.
  - Memory Access
    To specify a memory access event, select the "READ or WRITE or R/W" in the ACCESS area of the event. The event is established when memory is accessed at the specified address.

  Set the measurement events (measurement start event and measurement end event) at the Measurement Condition of the Time Measurement Window.

7.6.13.1 Specify the Execution Time Measurement Events

- Measuring the program execution time from when the program started to when it stops
  Select the below check box.



Execution Time Measure

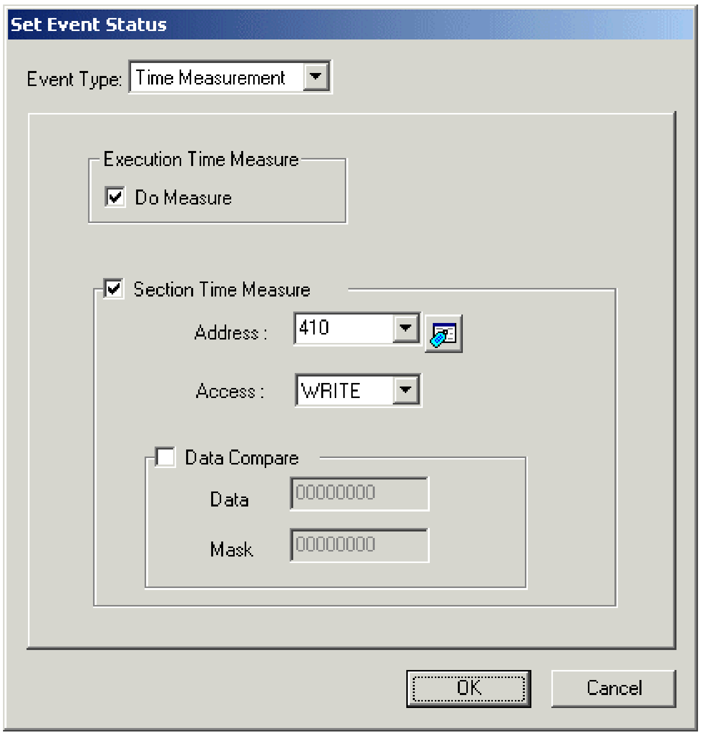
☑ Do Measure

The Execution time measurement event is set to the event E0 and the event E4.
Please note that the execution time measurement function doesn't operate when the Execution time measurement event is not set.

7.6.13.2 Specify the Interval Time Measurement Events

- **Writing/Reading a Specified Address**
  Set as below.

  Example: Writing to address 410h



Set Event Status

Event Type: Time Measurement

Execution Time Measure

☑ Do Measure

☑ Section Time Measure

Address : 410

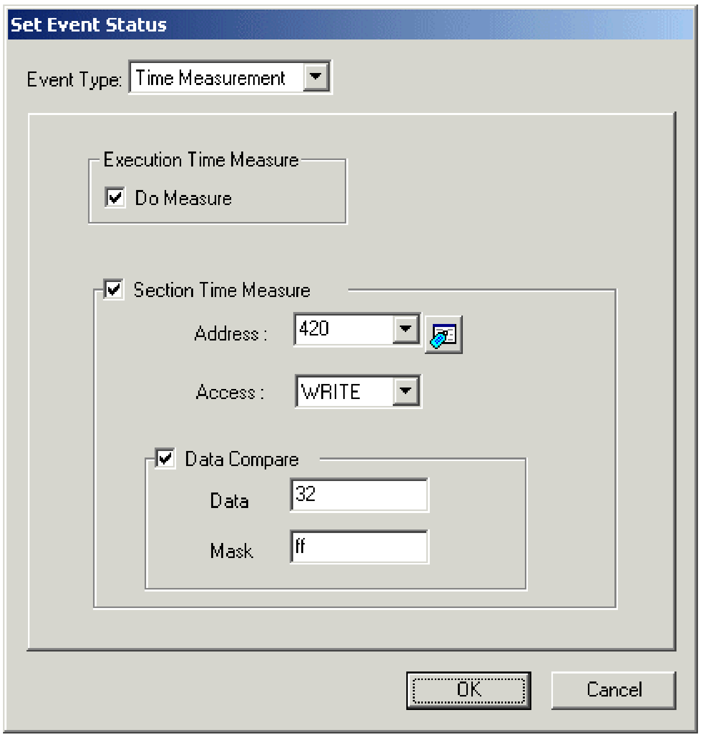
Access : WRITE

□ Data Compare

Data 00000000

Mask 00000000

Example: Writing byte length data 32h to address 420h



Set Event Status

Event Type: Time Measurement

Execution Time Measure

☑ Do Measure

☑ Section Time Measure

Address : 420

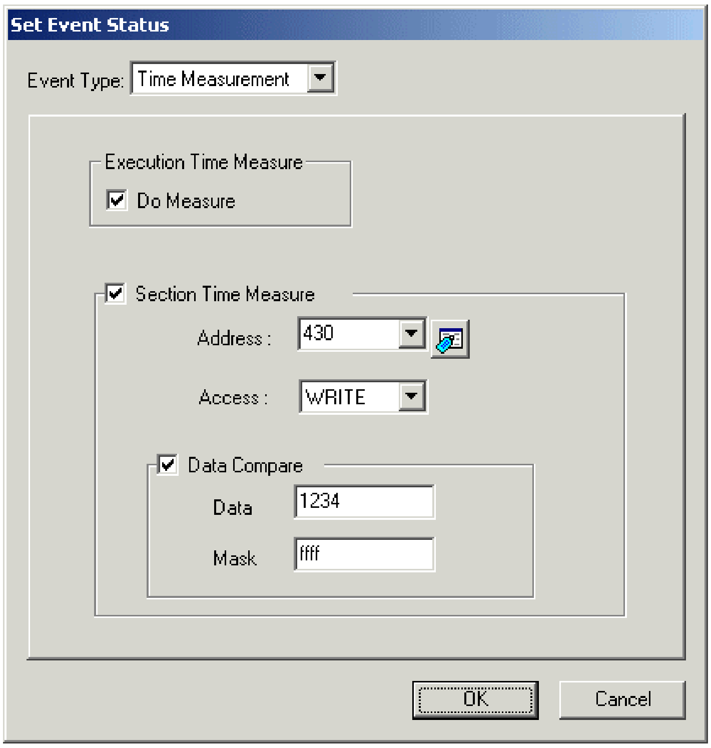
Access : WRITE

☑ Data Compare

Data 32

Mask ff

Example: Writing word length data 1234h to address 430h



Set Event Status

Event Type: Time Measurement

Execution Time Measure

☑ Do Measure

☑ Section Time Measure

Address : 430

Access : WRITE

☑ Data Compare

Data 1234

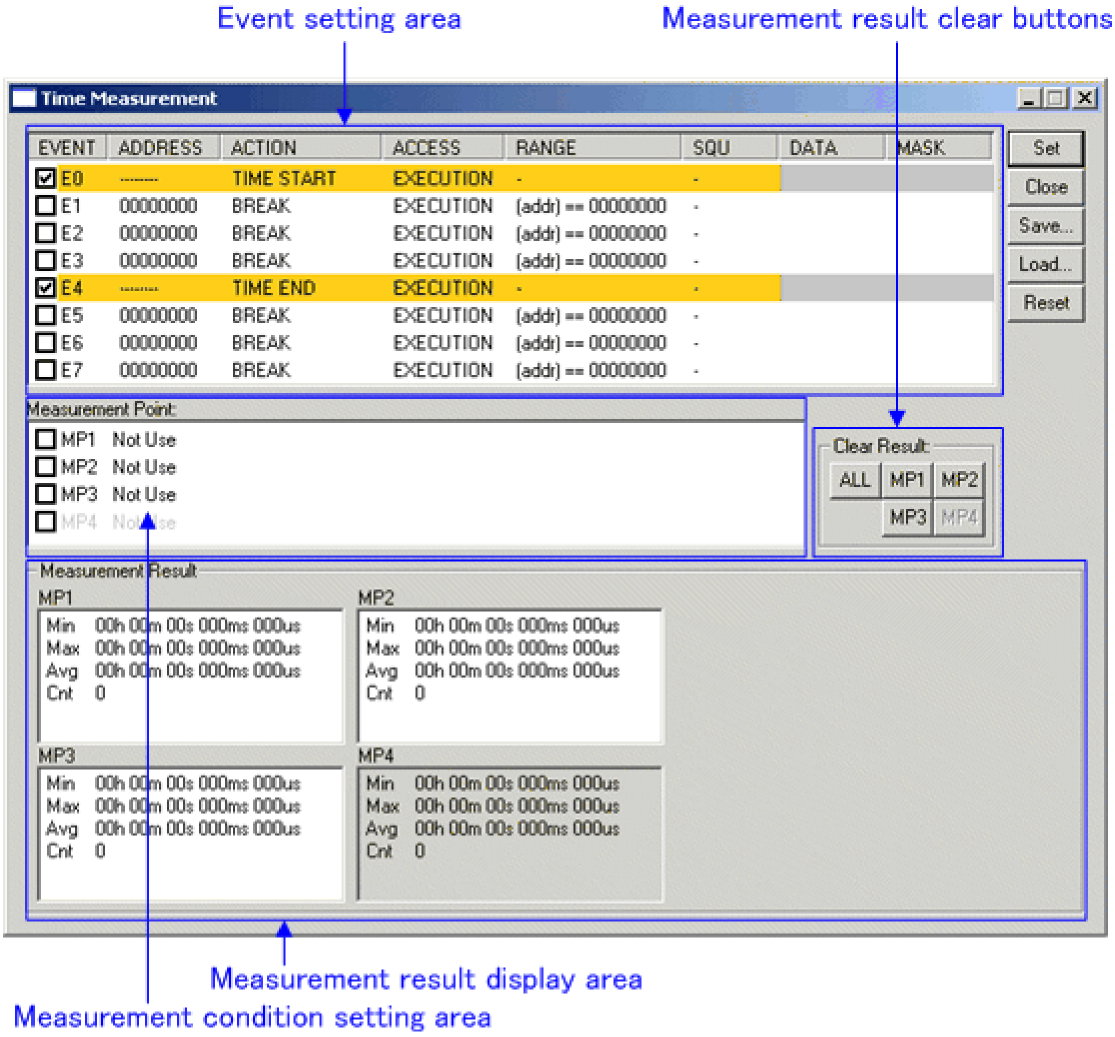
Mask ffff

ATTENTION

- Only when Time measurement mode is selected in the Debugging Mode tab of the Init dialog, Execution time measurement function can be used.

7.7 Time Measurement Window

The Time Measurement window displays the minimum/maximum/average execution time and measurement count at any measurement point. The execution time of up to 3 measurement points can be measured simultaneously. You can specify the event for the measurement condition in the same manner as when specifying events in the Event Setting Window.



Event setting area

Measurement result clear buttons

Measurement result display area

Measurement condition setting area

EVENT	ADDRESS	ACTION	ACCESS	RANGE	SQU	DATA	MASK
☑ E0	--------	TIME START	EXECUTION	-	-		
□ E1	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E2	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E3	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
☑ E4	--------	TIME END	EXECUTION	-	-		
□ E5	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E6	00000000	BREAK	EXECUTION	(addr) == 00000000	-		
□ E7	00000000	BREAK	EXECUTION	(addr) == 00000000	-		

Measurement Point

□ MP1 Not Use
□ MP2 Not Use
□ MP3 Not Use
□ MP4 Not Use

Measurement Result

```
MP1                              MP2
Min  00h 00m 00s 000ms 000us     Min  00h 00m 00s 000ms 000us
Max  00h 00m 00s 000ms 000us     Max  00h 00m 00s 000ms 000us
Avg  00h 00m 00s 000ms 000us     Avg  00h 00m 00s 000ms 000us
Cnt  0                           Cnt  0

MP3                              MP4
Min  00h 00m 00s 000ms 000us     Min  00h 00m 00s 000ms 000us
Max  00h 00m 00s 000ms 000us     Max  00h 00m 00s 000ms 000us
Avg  00h 00m 00s 000ms 000us     Avg  00h 00m 00s 000ms 000us
Cnt  0                           Cnt  0
```

- If the contents of events are altered, they are marked by an asterisk (*) on the title bar. The asterisks (*) are not displayed after setting up the emulator.

ATTENTION

- The Event Setting Window and the Time Measure Windows use the same resource of the emulator. If the event settings are modified in Time Measure Window, settings of the Event Setting Window are modified, too.

7.7.1 Specify the Time Measurement Event

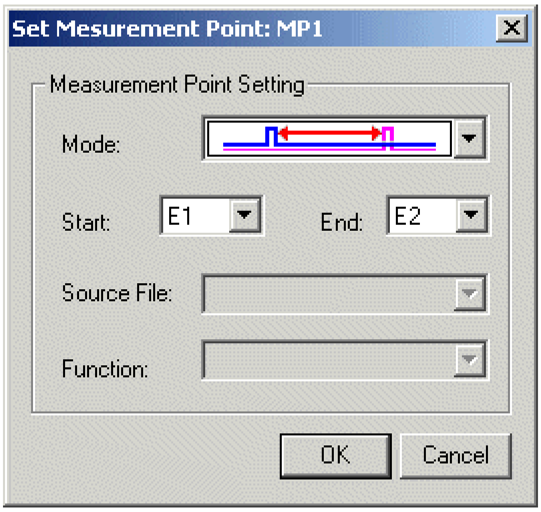
The events listed below can be specified as measurement events.

- Memory Access

To set events, double-click to the event setting area of the Time Measurement Window. This opens an event setting dialog box.
For details on how to specify an interval time measurement event, see "7.6.13 Specify the Time Measurement Events."

7.7.2 Time Measurement Condition

For the time measurement conditions, the following can be specified for each measurement interval.



Set Mesurement Point: MP1

Measurement Point Setting

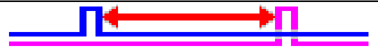
Mode:

Start: E1

End: E2

Source File:

Function:

	Measures the time in an interval from where the start event is established till where the end event is established.

7.7.3 Command Button

The buttons on this window has the following meanings.

Button	Function
Reset	Discards the contents being displayed in the window and loads contents from the emulator in which they were set.
Save...	Saves the contents set in the window to a file.
Load...	Loads event information from a file in which it was saved.
Set	Sends the contents set in the window to the emulator.
Close	Closes the window.

7.7.4 Set the Measurement Condition

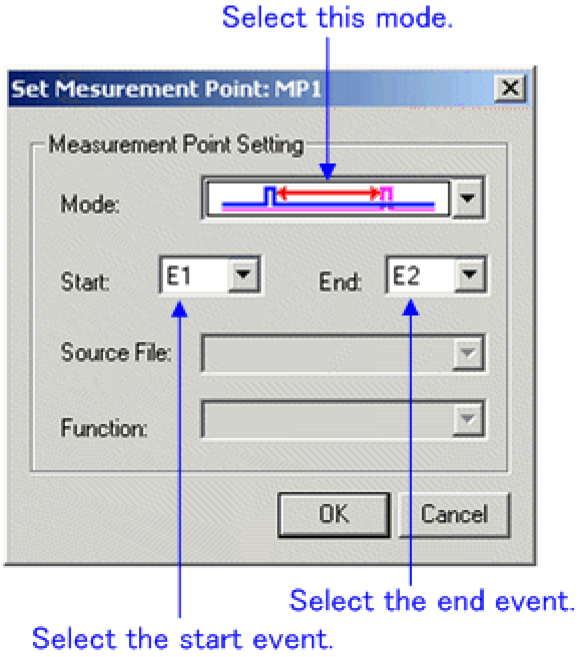
For the debugger, the following measurement conditions can be specified.

- Measure the execution time between the events.

Up to three measurement intervals can be specified. To specify measurement intervals, click any line (MP1-MP3) in the Measurement Point group of the Interval Time Measure Window. This opens a dialog box for specifying measurement conditions.

7.7.4.1 Measure the execution time between the events

1. Set the measurement events (measurement start event and measurement end event).
2. Specify the following in the Measurement Condition Designation dialog.



Select this mode.

Select the end event.

Select the start event.

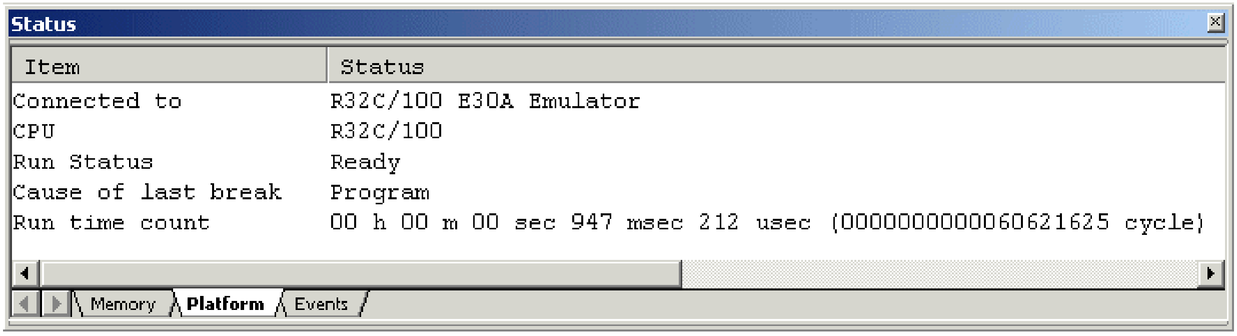
ATTENTION

- The time measurement interval ranges from the location where a start event occurs to the location where an end event occurs. However, this does not include the point in time at which an end event occurs.

7.7.5 Reference the time measurement results

7.7.5.1 Reference the execution time measurement results

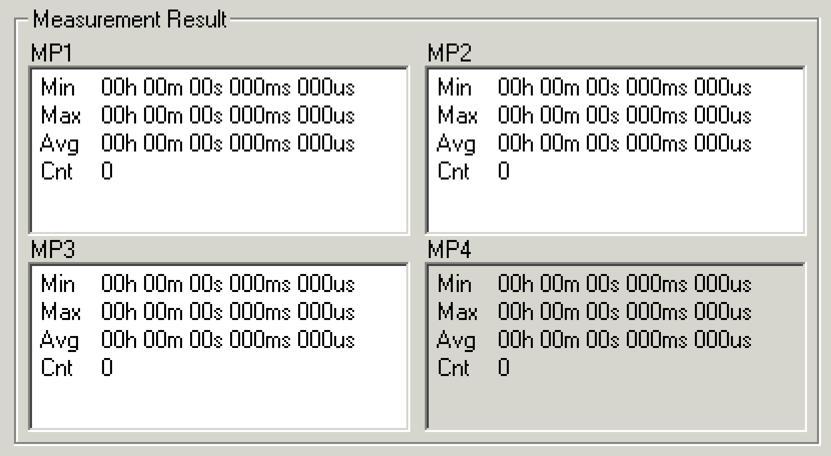
The point execution time measurement results are displayed in the Platform tab of the Status window.
The cumulative result is displayed when measured two or more times.



Item	Status
Connected to	R32C/100 E30A Emulator
CPU	R32C/100
Run Status	Ready
Cause of last break	Program
Run time count	00 h 00 m 00 sec 947 msec 212 usec (0000000000060621625 cycle)

7.7.5.2 Reference the interval time measurement results

The point time measurement results are displayed at the bottom of the Point Time Measurement window.



Measurement Result

MP1
```
Min   00h 00m 00s 000ms 000us
Max   00h 00m 00s 000ms 000us
Avg   00h 00m 00s 000ms 000us
Cnt   0
```

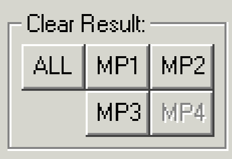
MP2
```
Min   00h 00m 00s 000ms 000us
Max   00h 00m 00s 000ms 000us
Avg   00h 00m 00s 000ms 000us
Cnt   0
```

MP3
```
Min   00h 00m 00s 000ms 000us
Max   00h 00m 00s 000ms 000us
Avg   00h 00m 00s 000ms 000us
Cnt   0
```

MP4
```
Min   00h 00m 00s 000ms 000us
Max   00h 00m 00s 000ms 000us
Avg   00h 00m 00s 000ms 000us
Cnt   0
```

7.7.5.3 Clear the measurement results

Click the button of the measurement result to be cleared.



You can clear all the measurement results by clicking the ALL button.

7.8 Trace Window

The Trace Window is used to display the results of real-time trace measurement.

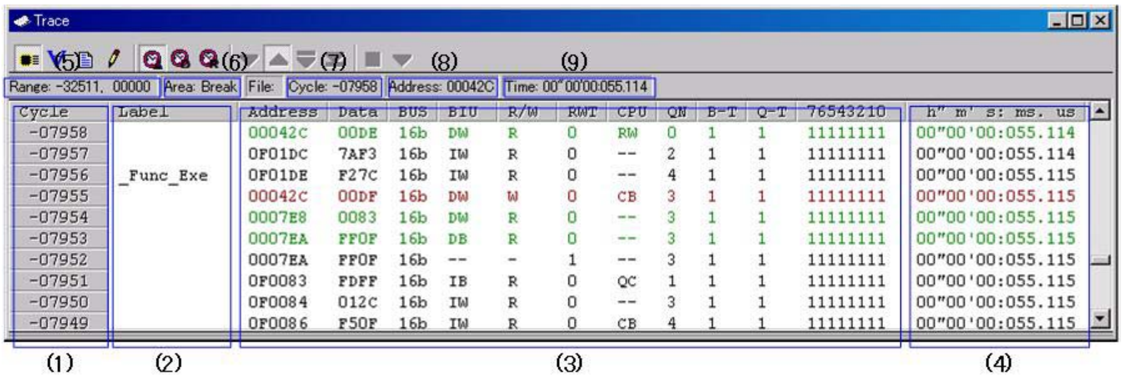
- Bus mode
  This mode allows you to inspect cycle-by-cycle bus information. The display content depends on the MCU and simulator system used. In addition to bus information, this mode allows disassemble, source line or data access information to be displayed in combination.
- Disassemble mode
  This mode allows you to inspect the executed instructions. In addition to disassemble information, this mode allows source line or data access information to be displayed in combination.
- Data access mode
  This mode allows you to inspect the data read/write cycles. In addition to data access information, this mode allows source line information to be displayed in combination.
- Source mode
  This mode allows you to inspect the program execution path in the source program.

The measurement result is displayed when a trace measurement has finished. When a trace measurement restarts, the window display is cleared.

The range of a trace measurement can be altered in the Trace Point Setting Window. For details about this window, refer to "7.6 Event Setting Window" With default settings, the trace information immediately before the program has stopped is recorded.

7.8.1 Configuration of Bus Mode

When bus mode is selected, trace information is displayed in bus mode. Bus mode is configured as shown below. The display content in bus mode differs depending on the MCU or simulator system used.

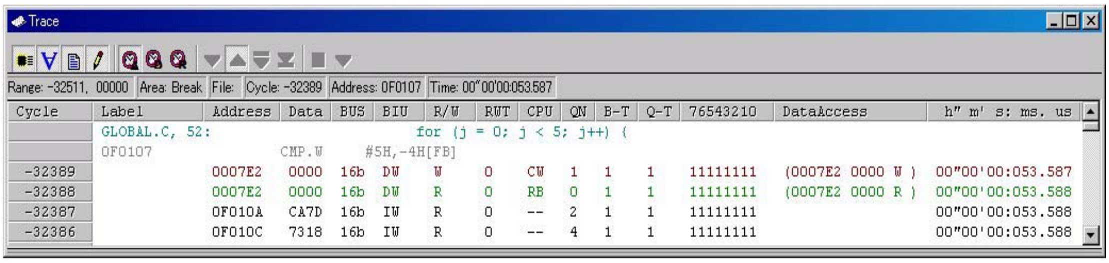


Range: -32511, 00000 | Area: Break | File: | Cycle: -07958 | Address: 00042C | Time: 00"00'00:055.114

Cycle	Label	Address	Data	BUS	BIU	R/W	RWT	CPU	QN	B-T	Q-T	76543210	h" m' s: ms. us
-07958		00042C	00DE	16b	DW	R	0	RW	0	1	1	11111111	00"00'00:055.114
-07957		0F01DC	7AF3	16b	IW	R	0	--	2	1	1	11111111	00"00'00:055.114
-07956	_Func_Exe	0F01DE	F27C	16b	IW	R	0	--	4	1	1	11111111	00"00'00:055.115
-07955		00042C	00DF	16b	DW	W	0	CB	3	1	1	11111111	00"00'00:055.115
-07954		0007E8	0083	16b	DW	R	0	--	3	1	1	11111111	00"00'00:055.115
-07953		0007EA	FF0F	16b	DB	R	0	--	3	1	1	11111111	00"00'00:055.115
-07952		0007EA	FF0F	16b	--	-	1	--	3	1	1	11111111	00"00'00:055.115
-07951		0F0083	FDFF	16b	IB	R	0	QC	1	1	1	11111111	00"00'00:055.115
-07950		0F0084	012C	16b	IW	R	0	--	3	1	1	11111111	00"00'00:055.115
-07949		0F0086	F50F	16b	IW	R	0	CB	4	1	1	11111111	00"00'00:055.115

1. Cycle display area: Shows trace cycles. Double-click here to bring up a dialog box to change the displayed cycle.
2. Label display area: Shows labels corresponding to address bus information. Double-click here to bring up a dialog box to search for addresses.
3. Bus information display area: The content displayed here differs depending on the MCU or simulator system used.
   - Refer to "7.8.6 Display of bus information on the R32C Debugger"
4. Time information display area: Shows time information of trace measurement result. One of the following three modes can be selected from the menu. (Not supported.)
   - Absolute Time:Shows an elapsed time from the time the program started running up to now in terms of absolute time (default).
   - Differences:Shows a differential time from the immediately preceding cycle.
   - Relative Time:Shows a relative time from the selected cycle. Note, however, that this mode changes to the absolute time display mode when the trace measurement result is updated.
5. Acquired range of trace measurement result: Shows the currently acquired range of trace measurement result.
6. Trace measurement range: Shows the currently set range of trace measurement.
7. First line cycle: Shows the cycle of the first line displayed.
8. First line address: Shows the address of the first line displayed.
9. First line time: First line time: Shows the time information of the first line displayed.
10. Window splitting box: Double-clicking this box splits the window into parts.

In addition to bus information, the window can display disassemble, source line or data access information in combination. In this case, the display will be similar to the one shown below.

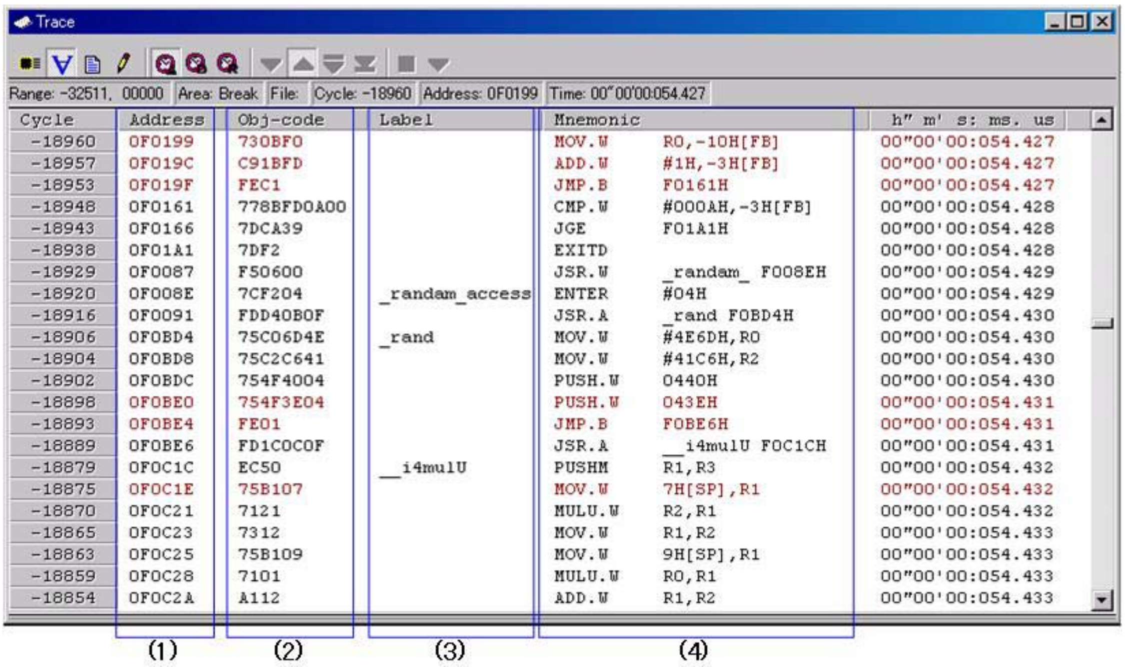


Range: -32511, 00000 | Area: Break | File: | Cycle: -32389 | Address: 0F0107 | Time: 00"00'00:053.587

```
Cycle   Label          Address  Data  BUS  BIU  R/W  RWT  CPU  QN  B-T  Q-T  76543210  DataAccess           h" m' s: ms. us
        GLOBAL.C, 52:                            for (j = 0; j < 5; j++) {
        0F0107                  CMP.W     #5H,-4H[FB]
-32389                 0007E2   0000  16b  DW   W    0    CW   1   1    1    11111111  (0007E2 0000 W )   00"00'00:053.587
-32388                 0007E2   0000  16b  DW   R    0    RB   0   1    1    11111111  (0007E2 0000 R )   00"00'00:053.588
-32387                 0F010A   CA7D  16b  IW   R    0    --   2   1    1    11111111                     00"00'00:053.588
-32386                 0F010C   7318  16b  IW   R    0    --   4   1    1    11111111                     00"00'00:053.588
```

7.8.2 Configuration of Disassemble Mode

When disassemble mode is selected while bus mode is unselected, trace information is displayed in disassemble mode. Disassemble mode is configured as shown below.



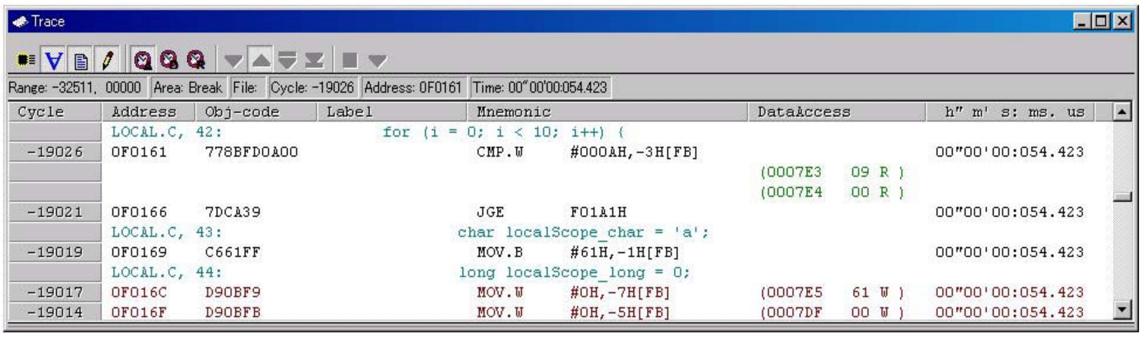
```
Range: -32511, 00000  Area: Break  File:  Cycle: -18960  Address: 0F0199  Time: 00"00'00:054.427

Cycle    Address  Obj-code    Label           Mnemonic                       h" m' s: ms. us
 -18960  0F0199   730BF0                      MOV.W    R0,-10H[FB]           00"00'00:054.427
 -18957  0F019C   C91BFD                      ADD.W    #1H,-3H[FB]           00"00'00:054.427
 -18953  0F019F   FEC1                        JMP.B    F0161H                00"00'00:054.427
 -18948  0F0161   778BFD0A00                  CMP.W    #000AH,-3H[FB]        00"00'00:054.428
 -18943  0F0166   7DCA39                      JGE      F01A1H                00"00'00:054.428
 -18938  0F01A1   7DF2                        EXITD                          00"00'00:054.428
 -18929  0F0087   F50600                      JSR.W    _randam_ F008EH       00"00'00:054.429
 -18920  0F008E   7CF204      _randam_access  ENTER    #04H                  00"00'00:054.429
 -18916  0F0091   FDD40B0F                    JSR.A    _rand F0BD4H          00"00'00:054.430
 -18906  0F0BD4   75C06D4E    _rand           MOV.W    #4E6DH,R0             00"00'00:054.430
 -18904  0F0BD8   75C2C641                    MOV.W    #41C6H,R2             00"00'00:054.430
 -18902  0F0BDC   754F4004                    PUSH.W   0440H                 00"00'00:054.430
 -18898  0F0BE0   754F3E04                    PUSH.W   043EH                 00"00'00:054.431
 -18893  0F0BE4   FE01                        JMP.B    F0BE6H                00"00'00:054.431
 -18889  0F0BE6   FD1C0C0F                    JSR.A    __i4mulU F0C1CH       00"00'00:054.431
 -18879  0F0C1C   EC50        __i4mulU        PUSHM    R1,R3                 00"00'00:054.432
 -18875  0F0C1E   75B107                      MOV.W    7H[SP],R1             00"00'00:054.432
 -18870  0F0C21   7121                        MULU.W   R2,R1                 00"00'00:054.432
 -18865  0F0C23   7312                        MOV.W    R1,R2                 00"00'00:054.433
 -18863  0F0C25   75B109                      MOV.W    9H[SP],R1             00"00'00:054.433
 -18859  0F0C28   7101                        MULU.W   R0,R1                 00"00'00:054.433
 -18854  0F0C2A   A112                        ADD.W    R1,R2                 00"00'00:054.433
```

1. Address display area: Shows addresses corresponding to instructions. Double-click here to bring up a dialog box to search for addresses.
2. Object code display area: Shows the object codes of instructions.
3. Label display area: Shows labels corresponding to instruction addresses. Double-click here to bring up a dialog box to search for addresses.
4. Mnemonic display area: Shows the mnemonics of instructions.

Other display areas are the same as in bus mode.

In addition to disassemble information, the window can display source line or data access information in combination. In this case, the display will be similar to the one shown below.

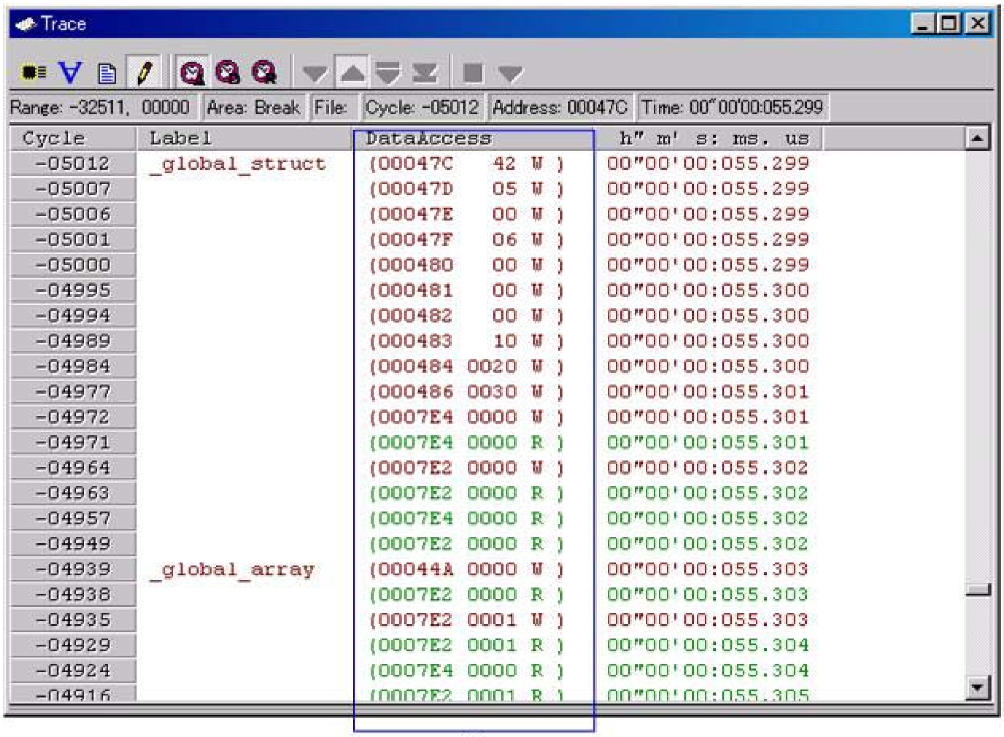


```
Range: -32511, 00000  Area: Break  File:  Cycle: -19026  Address: 0F0161  Time: 00"00'00:054.423

Cycle    Address  Obj-code    Label      Mnemonic                  DataAccess          h" m' s: ms. us
         LOCAL.C, 42:                 for (i = 0; i < 10; i++) {
 -19026  0F0161   778BFD0A00            CMP.W    #000AH,-3H[FB]                        00"00'00:054.423
                                                                   (0007E3   09 R )
                                                                   (0007E4   00 R )
 -19021  0F0166   7DCA39                JGE      F01A1H                                00"00'00:054.423
         LOCAL.C, 43:                char localScope_char = 'a';
 -19019  0F0169   C661FF                MOV.B    #61H,-1H[FB]                          00"00'00:054.423
         LOCAL.C, 44:                long localScope_long = 0;
 -19017  0F016C   D90BF9                MOV.W    #0H,-7H[FB]       (0007E5   61 W )    00"00'00:054.423
 -19014  0F016F   D90BFB                MOV.W    #0H,-5H[FB]       (0007DF   00 W )    00"00'00:054.423
```

7.8.3 Configuration of Data Access Mode

When data access mode is selected while bus mode and disassemble mode are unselected, trace information is displayed in data access mode. Data access mode is configured as shown below.



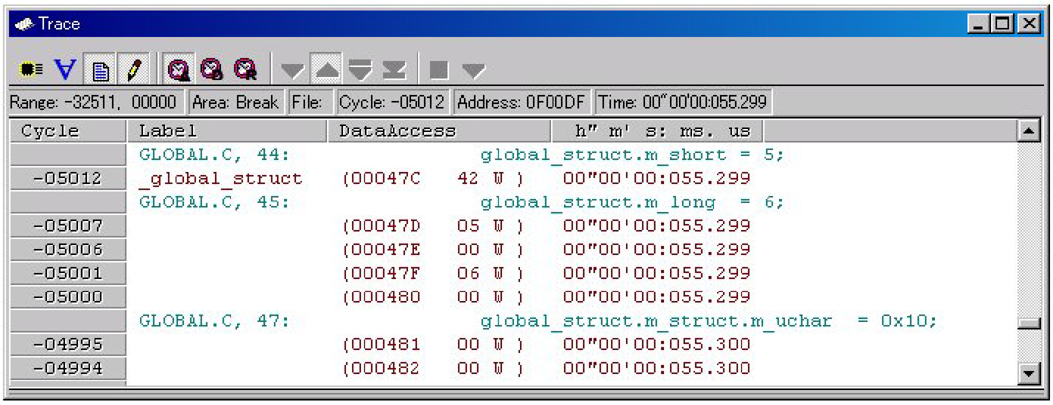
```
Range: -32511, 00000  Area: Break  File:  Cycle: -05012  Address: 00047C  Time: 00"00'00:055.299
Cycle    Label            DataAccess              h" m' s: ms. us
-05012   _global_struct   (00047C    42  W )      00"00'00:055.299
-05007                    (00047D    05  W )      00"00'00:055.299
-05006                    (00047E    00  W )      00"00'00:055.299
-05001                    (00047F    06  W )      00"00'00:055.299
-05000                    (000480    00  W )      00"00'00:055.299
-04995                    (000481    00  W )      00"00'00:055.300
-04994                    (000482    00  W )      00"00'00:055.300
-04989                    (000483    10  W )      00"00'00:055.300
-04984                    (000484  0020  W )      00"00'00:055.300
-04977                    (000486  0030  W )      00"00'00:055.301
-04972                    (0007E4  0000  W )      00"00'00:055.301
-04971                    (0007E4  0000  R )      00"00'00:055.301
-04964                    (0007E2  0000  W )      00"00'00:055.302
-04963                    (0007E2  0000  R )      00"00'00:055.302
-04957                    (0007E4  0000  R )      00"00'00:055.302
-04949                    (0007E2  0000  R )      00"00'00:055.302
-04939   _global_array    (00044A  0000  W )      00"00'00:055.303
-04938                    (0007E2  0000  R )      00"00'00:055.303
-04935                    (0007E2  0001  W )      00"00'00:055.303
-04929                    (0007E2  0001  R )      00"00'00:055.304
-04924                    (0007E4  0000  R )      00"00'00:055.304
-04916                    (0007E2  0001  R )      00"00'00:055.305
```

(1)

1. Data access display area: Shows data access information. If the information displayed here is "000400 1234 W," for example, it means that data "1234H" was written to the address 000400H in 2-byte width.

Other display areas are the same as in bus mode.

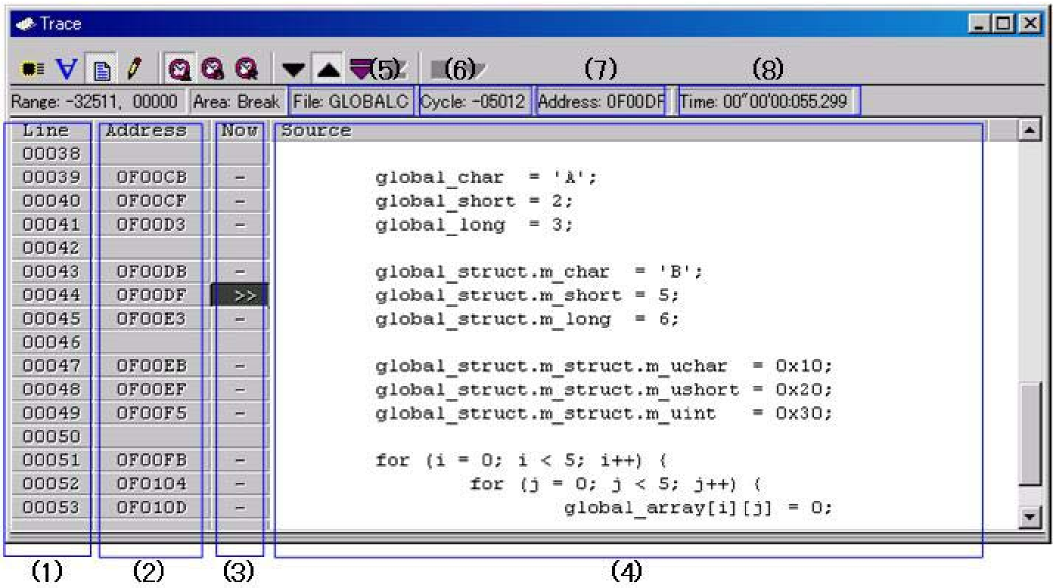
In addition to data access information, the window can display source line information in combination. In this case, the display will be similar to the one shown below.



```
Range: -32511, 00000  Area: Break  File:  Cycle: -05012  Address: 0F00DF  Time: 00"00'00:055.299
Cycle    Label             DataAccess           h" m' s: ms. us
         GLOBAL.C, 44:                   global_struct.m_short = 5;
-05012   _global_struct    (00047C   42  W )    00"00'00:055.299
         GLOBAL.C, 45:                   global_struct.m_long  = 6;
-05007                     (00047D   05  W )    00"00'00:055.299
-05006                     (00047E   00  W )    00"00'00:055.299
-05001                     (00047F   06  W )    00"00'00:055.299
-05000                     (000480   00  W )    00"00'00:055.299
         GLOBAL.C, 47:                   global_struct.m_struct.m_uchar  = 0x10;
-04995                     (000481   00  W )    00"00'00:055.300
-04994                     (000482   00  W )    00"00'00:055.300
```

7.8.4 Configuration of Source Mode

When only source mode is selected, trace information is displayed in source mode. Source mode is configured as shown below.



```
Range: -32511, 00000 | Area: Break | File: GLOBALC | Cycle: -05012 | Address: 0F00DF | Time: 00"00'00:055.299

Line   Address  Now  Source
00038
00039  0F00CB   -            global_char  = 'A';
00040  0F00CF   -            global_short = 2;
00041  0F00D3   -            global_long  = 3;
00042
00043  0F00DB   -            global_struct.m_char  = 'B';
00044  0F00DF   >>           global_struct.m_short = 5;
00045  0F00E3   -            global_struct.m_long  = 6;
00046
00047  0F00EB   -            global_struct.m_struct.m_uchar  = 0x10;
00048  0F00EF   -            global_struct.m_struct.m_ushort = 0x20;
00049  0F00F5   -            global_struct.m_struct.m_uint   = 0x30;
00050
00051  0F00FB   -            for (i = 0; i < 5; i++) {
00052  0F0104   -                    for (j = 0; j < 5; j++) {
00053  0F010D   -                            global_array[i][j] = 0;
```

1. Line number display area: Shows the line number information of the displayed file. Double-click here to bring up a dialog box to change the displayed file.
2. Address display area: Shows addresses corresponding to source lines. Double-click here to bring up a dialog box to search for addresses.
3. Referenced cycle display area: Shows the currently referenced cycle that is marked by ">>." Furthermore, the addresses corresponding to source lines, if any, are marked by "-."
4. Source display area: Shows the content of the source file.
5. File name: Shows the file name of the currently displayed source file.
6. Referenced cycle: Shows the currently referenced cycle.
7. Referenced address: Shows the address corresponding to the currently referenced cycle.
8. Referenced time: Shows the time information corresponding to the currently referenced cycle.

Other display areas are the same as in bus mode.

7.8.5 Extended Menus

This window has the following popup menus that can be brought up by right-clicking in the window.

Menu		Function
BUS		Display the information of BUS mode.
DIS		Display the information of Disassemble mode.
SRC		Display the information of Source mode.
DATA		Display the information of Data access mode.
View	Cycle...	Changes the displayed position by specifying a cycle.
	Address...	Changes the displayed position by searching an address.
	Source...	Display a selected source file.
Time	Absolute Time	Shows elapsed time from the time the program started running up to now in terms of absolute time.
	Differences	Shows a differential time from the immediately preceding displayed cycle.
	Relative Time	Shows a relative time from the currently selected cycle.
Trace	Forward	Changes the direction of search to forward direction.
	Backward	Changes the direction of search to reverse direction.
	Step	Searches in Step mode in the specified direction of search.
	Come	Searches in Come mode in the specified direction of search.
	Stop	Stops trace measurement in the middle and displays the measured content at the present point of time.
	Restart	Restarts trace measurement.
Layout...		Change layout of the corrent view.
Copy		Copy selected lines.
Save...		Save trace data to file.
Load...		Load trace data from file.
Toolbar display		Display toolbar.
Customize toolbar...		Open toolbar customize dialog box.
Allow Docking		Allow window docking.
Hide		Hide window.

7.8.6 Display of bus information on the R32C Debugger

From left to right, the contents are as follows:

- Src, Dest
  The status of the address bus
- Data
  The status of the data bus
- Size
  The data access size

Representation	BIU status
B	8bit
W	16bit
L	32bit
Q	64bit

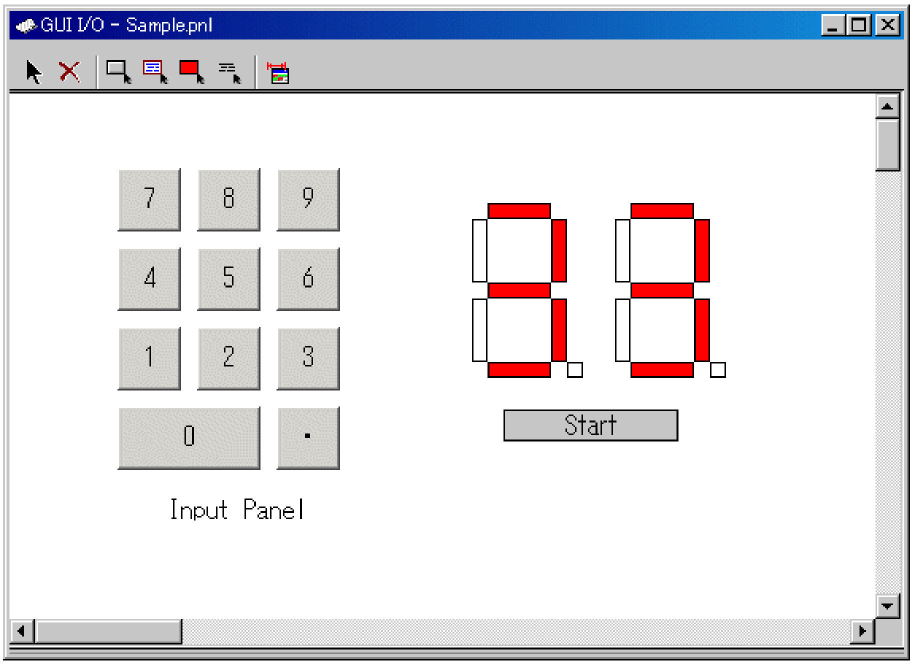
- Status
  The status between the memory and I/O.

Representation	Status	Factor
JMP	Jump/Return	Records as branch information. Src is branch instruction address. Dest is jump address.
RD	Read access	Records as data access information.
WR	Write access	Records as data access information.

- Jcnd
  The status ('0' true or '1' false) of the condition branch instruction.

7.9 GUI I/O Window

The GUI I/O window allows you for port input by creating a user target system key input panel (button) in the window and clicking the created button. And this window also allows you to implement the user target system output panel in the window.



- You can arrange the following parts on the window.

- Label (character string)
  Displays/erases a character string specified by the user when any value is written to the specified address (bit).
- LED
  Changes the display color of any area when any value is written to the specified address (bit). (Substitution for LED ON)
- Button
  A virtual port input can be executed at the time the button is pressed.
- Text
  Display the text string.

- You can also save the created panel in a file and reload it.
- You can set up to 200 address points to the created part. If different addresses are set to the individual parts, you can arrange up to 200 parts.

7.9.1 Extended Menus

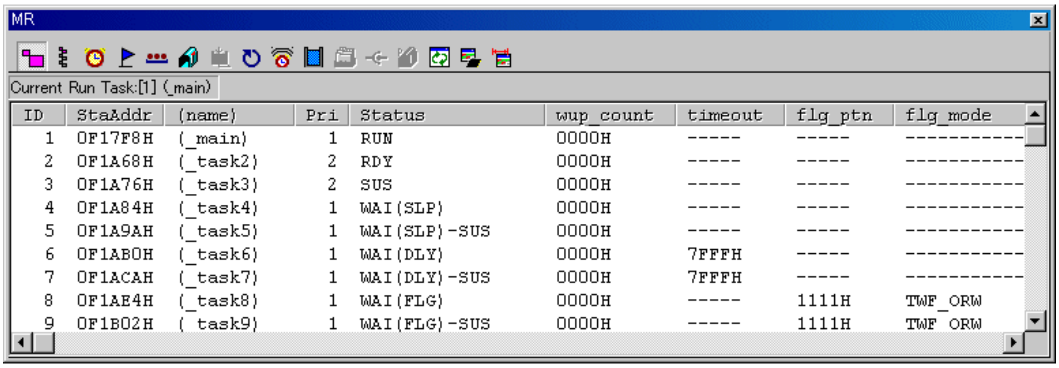
This window has the following popup menus that can be brought up by right-clicking in the window.

Menu	Function
Select Item	Select an I/O item.
Delete	Delete the selected I/O item.
Copy	Copy the selected I/O item.
Paste	Paste the copied I/O item.
Create Button	Create a new button item.
Create Label	Create a new label item.
Create LED	Create a new LED item.
Create Text	Create a new text item.
Display grid	Display the grid line.
Save...	Save I/O panel file.
Load...	Load I/O panel file.
Sampling Period...	Set RAM monitor sampling period.
Toolbar display	Display toolbar.
Customize toolbar...	Open toolbar customize dialog box.
Allow Docking	Allow window docking.
Hide	Hide window.

7.10 MR Window

Use the MR Window to display the status of the realtime OS.

You can only use the MR Window when you have downloaded a program that uses the realtime OS (if the downloaded program does not use the MR, nothing is displayed in the MR Window when it is opened.)



Current Run Task:[1] (_main)

ID	StaAddr	(name)	Pri	Status	wup_count	timeout	flg_ptn	flg_mode
1	0F17F8H	(_main)	1	RUN	0000H	-----	-----	-----------
2	0F1A68H	(_task2)	2	RDY	0000H	-----	-----	-----------
3	0F1A76H	(_task3)	2	SUS	0000H	-----	-----	-----------
4	0F1A84H	(_task4)	1	WAI(SLP)	0000H	-----	-----	-----------
5	0F1A9AH	(_task5)	1	WAI(SLP)-SUS	0000H	-----	-----	-----------
6	0F1AB0H	(_task6)	1	WAI(DLY)	0000H	7FFFH	-----	-----------
7	0F1ACAH	(_task7)	1	WAI(DLY)-SUS	0000H	7FFFH	-----	-----------
8	0F1AE4H	(_task8)	1	WAI(FLG)	0000H	-----	1111H	TWF_ORW
9	0F1B02H	(_task9)	1	WAI(FLG)-SUS	0000H	-----	1111H	TWF_ORW

- You can open the MR window as many as the number of display modes .
- By clicking the desired button, the MR window display mode changes and the display data also changes.
- By double-clicking the desired task line, you can display the context data of the task.
- You can drag the cursor to change the width of the display area in each mode.
- If the downloaded program does not use MR, you cannot select all the menu which will select the display mode.
- The usable display mode depends on MRxx.

ATTENTION

Please use the startup file (crt0mr.axx/start.axx) whose contents matches with the version of MRxx, when you make downloaded program. The MR Window and MR command will not run properly if the startup file you uses don't match with the version of MRxx.

7.10.1 Extended Menus

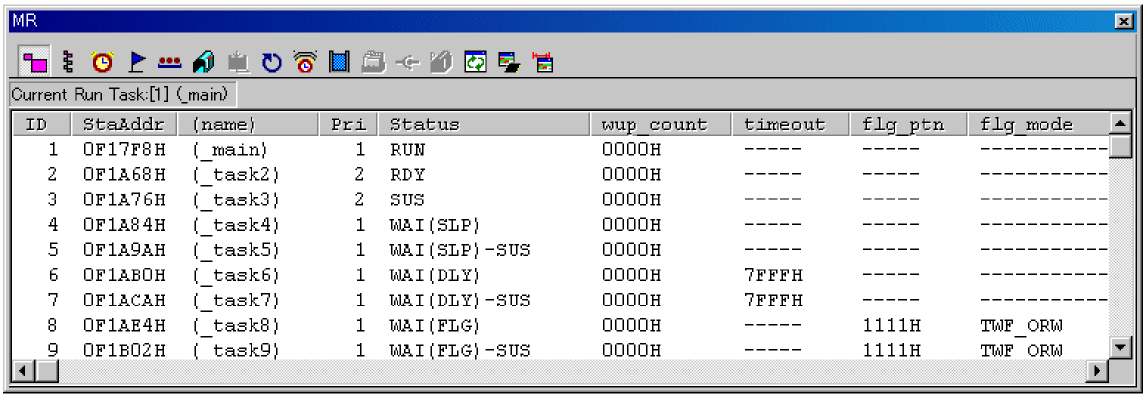
This window has the following popup menus that can be brought up by right-clicking in the window.

Menu		**Function**
Mode	Task	Displays Task status.
	Ready Queue	Displays Ready status.
	Timeout Queue	Displays Timeout status.
	Event Flag	Displays Event Flag status.
	Semaphore	Displays Semaphore status.
	Mailbox	Displays Mailbox status.
	Data Queue	Displays Data Queue status.
	Cyclic Handler	Displays Cyclic Handler status.
	Alarm Handler	Displays Alarm Handler status.
	Memory Pool	Displays Memory Pool status.
	Message Buffer*	Displays Message Buffer status.
	Port	Displays Port status.
	Mailbox(with Priority)	Displays Mailbox(with Priority) status.
Context...		Displays Context.
Layout	Status Bar	Switch display or non-display of status bar.
Refresh		Refresh memory data.
RAM Monitor	Enable RAM Monitor	Switch enable or disable RAM Monitor function.
	Sampling Period...	Set RAM Monitor sampling period.
Toolbar display		Display toolbar.
Customize toolbar...		Open toolbar customize dialog box.
Allow Docking		Allow window docking.
Hide		Hide window.

*: Not supported.

7.10.2 Display the Task Status

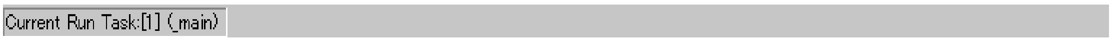
In the MR window, select Popup Menu - [Mode] -> [Task].



Current Run Task:[1] (_main)

ID	StaAddr	(name)	Pri	Status	wup_count	timeout	flg_ptn	flg_mode
1	0F17F8H	(_main)	1	RUN	0000H	-----	-----	-----------
2	0F1A68H	(_task2)	2	RDY	0000H	-----	-----	-----------
3	0F1A76H	(_task3)	2	SUS	0000H	-----	-----	-----------
4	0F1A84H	(_task4)	1	WAI(SLP)	0000H	-----	-----	-----------
5	0F1A9AH	(_task5)	1	WAI(SLP)-SUS	0000H	-----	-----	-----------
6	0F1AB0H	(_task6)	1	WAI(DLY)	0000H	7FFFH	-----	-----------
7	0F1ACAH	(_task7)	1	WAI(DLY)-SUS	0000H	7FFFH	-----	-----------
8	0F1AE4H	(_task8)	1	WAI(FLG)	0000H	-----	1111H	TWF_ORW
9	0F1B02H	(_task9)	1	WAI(FLG)-SUS	0000H	-----	1111H	TWF_ORW

By double-clicking any line, the information on the task context is displayed in the Context dialog. For details on the Context dialog, see "7.10.12 Display the Task Context"
The following data is displayed in the status bar.



Current Run Task:[1] (_main)

7.10.2.1 Display the Task Status(When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

All the tasks defined in the configuration are listed in the order of ID number. The function of each item is as described below. (When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

Items	Contents
ID	Task ID
StaAddr	Starting address of task
(name)	Task name
Pri	Priority
Status*1	Task status
wup_count	Wake-up count
timeout	Timeout value
flg_ptn	Wait bit pattern of event flag
flg_mode*2	Wait cancellation condition of event flag

- *1Task Status

Display	Status
RUN	RUNNING state
RDY	READY state
SUS	SUSPENDED state
DMT	DORMANT state
WAI(SLP)	Sleeping state
WAI(SLP)-SUS	Sleeping state (suspended)
WAI(SLP-TMO)	Sleeping state with time-out
WAI(SLP-TMO)-SUS	Sleeping state with time-out (suspended)
WAI(DLY)	Delayed state due to dly_tsk
WAI(DLY)-SUS	Delayed state due to dly_tsk (suspended)
WAI(FLG)	Waiting state for an eventflag
WAI(FLG)-SUS	Waiting state for an eventflag (suspended)
WAI(FLG-TMO)	Waiting state for an eventflag with time-out
WAI(FLG-TMO)-SUS	Waiting state for an eventflag with time-out (suspended)
WAI(SEM)	Waiting state for a semaphore resource
WAI(SEM)-SUS	Waiting state for a semaphore resource (suspended)
WAI(SEM-TMO)	Waiting state for a semaphore resource with time-out
WAI(SEM-TMO)-SUS	Waiting state for a semaphore resource with time-out (suspended)
WAI(MBX)	Receiving waiting state for a mailbox
WAI(MBX)-SUS	Receiving waiting state for a mailbox (suspended)
WAI(MBX-TMO)	Receiving waiting state for a mailbox with time-out
WAI(MBX-TMO)-SUS	Receiving waiting state for a mailbox with time-out (suspended)

- *2Display the Wait Cancellation Condition of Event Flag

flg_mode	Status
TWF_ANDW	Waits for all bits set in the wait bit pattern to be set (AND wait)
TWF_ANDW+TWF_CLR	Clears the event flag to 0 when an AND wait has occurred and the task wait status has been cancelled
TWF_ORW	Waits for any one bit set in the wait bit pattern to be set (OR wait)
TWF_ORW+TWF_CLR	Clears the event flag to 0 when an OR wait has occurred and the task wait status has been cancelled

7.10.2.2 Display the Task Status(When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

All the tasks defined in the configuration are listed in the order of ID number. The function of each item is as described below. (When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

Items	Contents
ID	Task ID
Name	Task name
Pri	Priority
Status*1	Task status
Wupcnt	Wake-up count
Actcnt	Activated count
Tmout	Timeout value
Flgptn	Wait bit pattern of event flag
Wfmode*2	Wait cancellation condition of event flag

- *1Task Status

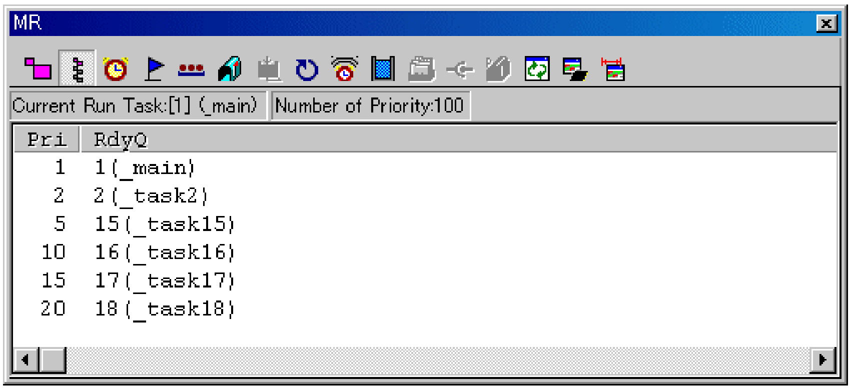
Display	Status
RUN	RUNNING state
RDY	READY state
SUS	SUSPENDED state
DMT	DORMANT state
WAI(SLP)	Sleeping state
WAI(SLP)-SUS	Sleeping state (suspended)
WAI(SLP-TMO)	Sleeping state with time-out
WAI(SLP-TMO)-SUS	Sleeping state with time-out (suspended)
WAI(DLY)	Delayed state due to dly_tsk
WAI(DLY)-SUS	Delayed state due to dly_tsk (suspended)
WAI(FLG)	Waiting state for an eventflag
WAI(FLG)-SUS	Waiting state for an eventflag (suspended)
WAI(FLG-TMO)	Waiting state for an eventflag
WAI(FLG-TMO)-SUS	Waiting state for an eventflag (suspended)
WAI(SEM)	Waiting state for a semaphore resource
WAI(SEM)-SUS	Waiting state for a semaphore resource (suspended)
WAI(SEM-TMO)	Waiting state for a semaphore resource with time-out
WAI(SEM-TMO)-SUS	Waiting state for a semaphore resource with time-out (suspended)
WAI(MBX)	Receiving waiting state for a mailbox
WAI(MBX)-SUS	Receiving waiting state for a mailbox (suspended)
WAI(MBX-TMO)	Receiving waiting state for a mailbox with time-out
WAI(MBX-TMO)-SUS	Receiving waiting state for a mailbox with time-out (suspended)
WAI(SDTQ)	Sending waiting state for a data queue
WAI(SDTQ)-SUS	Sending waiting state for a data queue (suspended)
WAI(SDTQ-TMO)	Sending waiting state for a data queue with time-out
WAI(SDTQ-TMO)-SUS	Sending waiting state for a data queue with time-out (suspended)
WAI(RDTQ)	Receiving waiting state for a data queue
WAI(RDTQ)-SUS	Receiving waiting state for a data queue (suspended)
WAI(RDTQ-TMO)	Receiving waiting state for a data queue with time-out
WAI(RDTQ-TMO)-SUS	Receiving waiting state for a data queue with time-out (suspended)
WAI(VSDTQ)	Sending waiting state for an extended data queue
WAI(VSDTQ)-SUS	Sending waiting state for an extended data queue (suspended)
WAI(VSDTQ-TMO)	Sending waiting state for an extended data queue with time-out
WAI(VSDTQ-TMO)-SUS	Sending waiting state for an extended data queue with time-out (suspended)
WAI(VRDTQ)	Receiving waiting state for an extended data queue
WAI(VRDTQ)-SUS	Receiving waiting state for an extended data queue (suspended)
WAI(VRDTQ-TMO)	Receiving waiting state for an extended data queue with time-out
WAI(VRDTQ-TMO)-SUS	Receiving waiting state for an extended data queue with time-out (suspended)
WAI(MPF)	Waiting state for a fixed-sized memory block
WAI(MPF)-SUS	Waiting state for a fixed-sized memory block (suspended)
WAI(MPF-TMO)	Waiting state for a fixed-sized memory block with time-out
WAI(MPF-TMO)-SUS	Waiting state for a fixed-sized memory block with time-out (suspended)

- *2 Display the Wait Cancellation Condition of Event Flag

Wfmode	Status
TWF_ANDW	Waits for all bits set in the wait bit pattern to be set (AND wait)
TWF_ORW	Waits for any one bit set in the wait bit pattern to be set (OR wait)

7.10.3 Display the Ready Queue Status

In the MR window, select Popup Menu - [Mode] -> [Ready Queue].



Current Run Task:[1] (_main) Number of Priority:100

```
Pri  RdyQ
  1  1(_main)
  2  2(_task2)
  5  15(_task15)
 10  16(_task16)
 15  17(_task17)
 20  18(_task18)
```

The following data is displayed in the status bar.

Current Run Task:[1] (_main) Number of Priority:100

7.10.3.1 Display the Ready Queue Status(When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

The function of each item is as described below. (When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

Item	Contents
Pri	Displays priority
RdyQ	Shows the ID Nos. and task names of tasks in the ready queue

- Up to 8 characters of the task name is displayed in the RdyQ field. When the task name exceeds 8 characters, the extra characters are omitted.

7.10.3.2 Display the Ready Queue Status(When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

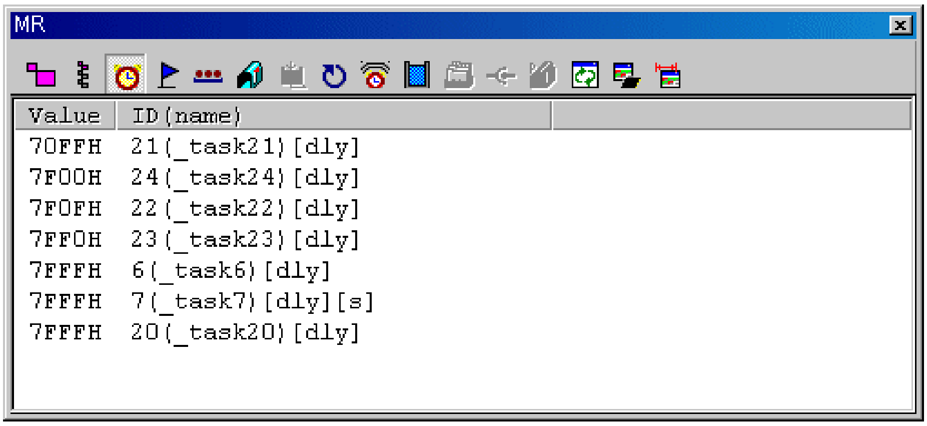
The function of each item is as described below. (When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

Item	Contents
Pri	Displays priority
Ready Queue	Shows the ID Nos. and task names of tasks in the ready queue

- Up to 8 characters of the task name is displayed in the Ready Queue field. When the task name exceeds 8 characters, the extra characters are omitted.

7.10.4 Display the Timeout Queue Status

In the MR window, select Popup Menu - [Mode] -> [Timeout Queue].



Value	ID(name)
70FFH	21(_task21)[dly]
7F00H	24(_task24)[dly]
7F0FH	22(_task22)[dly]
7FF0H	23(_task23)[dly]
7FFFH	6(_task6)[dly]
7FFFH	7(_task7)[dly][s]
7FFFH	20(_task20)[dly]

7.10.4.1 Display the Timeout Queue Status(When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

The function of each item is as described below.
Tasks waiting at present are displayed in the descending order of timeout value. (When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

Item	Contents
Value	Shows the timeout value of each task
ID(name)	Shows the ID No. and task name of the tasks in the timeout queue

- Following character strings are used to indicate the type of wait state.

Character string	Wait state
[slp]	Wait due to tslp_tsk
[dly]	Wait due to dly_tsk
[flg]	Wait due to twai_flg
[sem]	Wait due to twai_sem
[mbx]	Wait due to trcv_msg

- When a task connected to the timeout queue is in the state of forced waiting (double waiting), a string "[s]", which indicates double waiting, is appended to a string displayed in the ID (name) field.

Normal display	26(_task26)
Display when in WAIT-SUSPEND	26(_task26)[s]

7.10.4.2 Display the Timeout Queue Status(When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

The function of each item is as described below.
Tasks waiting at present are displayed in the descending order of timeout value. (When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

Item	Contents
Tmout	Shows the timeout value (ms) of each task
ID(Name)	Shows the ID No. and task name of the tasks in the timeout queue

- Following character strings are used to indicate the type of wait state.

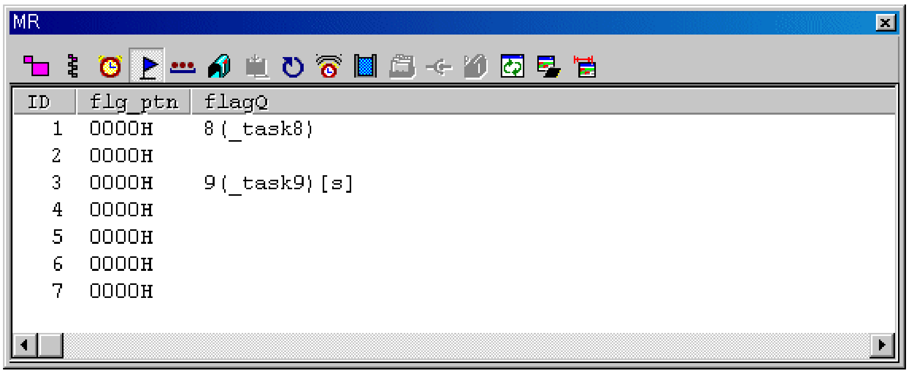
Character string	Wait state
[slp]	Wait due to tslp_tsk
[dly]	Wait due to dly_tsk
[flg]	Wait due to twai_flg
[sem]	Wait due to twai_sem
[mbx]	Wait due to trcv_mbx
[mpf]	Wait due to tget_mpf
[sdtq]	Wait due to tsnd_dtq
[rdtq]	Wait due to trcv_dtq
[vsdtq]	Wait due to vtsnd_dtq
[vrdtq]	Wait due to vtrcv_dtq

- When a task connected to the timeout queue is in the state of forced waiting (double waiting), a string "[s]", which indicates double waiting, is appended to a string displayed in the ID(Name) field.

Normal display	26(_task26)
Display when in WAIT-SUSPEND	26(_task26)[s]

7.10.5 Display the Event Flag Status

In the MR window, select Popup Menu - [Mode] -> [Event Flag].



ID	flg_ptn	flagQ
1	0000H	8(_task8)
2	0000H	
3	0000H	9(_task9)[s]
4	0000H	
5	0000H	
6	0000H	
7	0000H	

7.10.5.1 Display the Event Flag Status(When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

All the event flags defined in the configuration are listed in the order of ID number. The function of each item is listed below. (When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

Item	Contents
ID	ID No. of event flag
flg_ptn	Bit pattern of each event flag
flagQ	Task ID Nos. and task names in the event flag queue

- When a task connected to the event flag queue is in the state of waiting with timeout enabled (waiting in twai_flg), a string "[tmo]", which indicates a state of waiting with timeout enabled, is appended to a string displayed in the flag Q field.
  When a task connected to the event flag queue is in the state of forced waiting (double waiting), a string "[s]", which indicates double waiting, is appended to a string displayed in the flag Q field.

Normal Display	26(_task26)
Display when in WAIT-SUSPEND	26(_task26)[s]
Display when in WAIT-SUSPEND with time out	26(_task26)[tmo][s]

- Up to 8 characters can be displayed in the task name in the flag Q field.If a task name exceeds 8 characters, the extra characters are omitted.

7.10.5.2 Display the Event Flag Status(When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

All the event flags defined in the configuration are listed in the order of ID number. The function of each item is listed below. (When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

Item	Contents
ID	ID No. of event flag
Flgatr	Attribute of each event flag
Flgptn	Bit pattern of each event flag
Flag Queue	Task ID Nos. and task names in the event flag queue

- The following are displayed in the Flgatr area:

TA_TFIFO	Task wait queue is in FIFO order
TA_TPRI	Task wait queue is in task priority order
TA_WSGL	Only one task is allowed to be in the waiting state for the eventflag
TA_WMUL	Multiple tasks are allowed to be in the waiting state for the eventflag
TA_CLR	Eventflag's bit pattern is cleared when a task is released from the waiting state for that eventflag

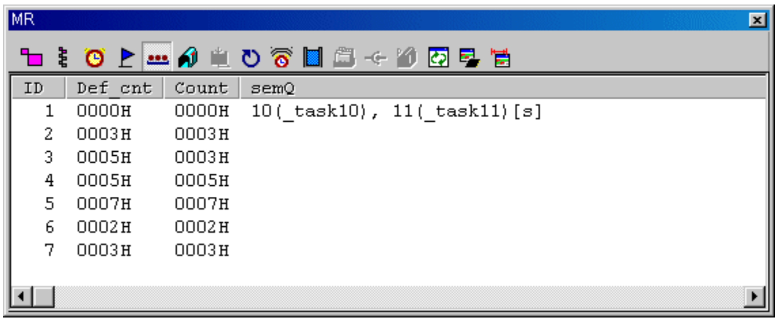
- When a task connected to the event flag queue is in the state of waiting with timeout enabled (waiting in twai_flg), a string "[tmo]", which indicates a state of waiting with timeout enabled, is appended to a string displayed in the Flag Queue field.
  When a task connected to the event flag queue is in the state of forced waiting (double waiting), a string "[s]", which indicates double waiting, is appended to a string displayed in the Flag Queue field.

Normal Display	26(_task26)
Display when in WAIT-SUSPEND	26(_task26)[s]
Display when in WAIT-SUSPEND with time out	26(_task26)[tmo][s]

- Up to 8 characters can be displayed in the task name in the Flag Queue field.If a task name exceeds 8 characters, the extra characters are omitted.

7.10.6 Display the Semaphore Status

In the MR window, select Popup Menu - [Mode] -> [Semaphore].



```
ID  Def_cnt  Count  semQ
 1  0000H    0000H  10(_task10), 11(_task11)[s]
 2  0003H    0003H
 3  0005H    0003H
 4  0005H    0005H
 5  0007H    0007H
 6  0002H    0002H
 7  0003H    0003H
```

7.10.6.1 Display the Semaphore Status(When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

All the SEMs defined in the configuration are listed in the order of ID number. The function of each item is listed below. (When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

Item	Contents
ID	ID No. of semaphore
Def_cnt	Default value of semaphore counter
Count	Semaphore count
semQ	Task ID Nos. and task names in the semaphore queue

- When a task connected to the SEM queue is in the state of waiting with timeout enabled (waiting in twai_sem), a string "[tmo]", which indicates a state of waiting with timeout enabled, is appended to a string displayed in the semQ field.
  When a task connected to the SEM queue is in the state of forced waiting (double waiting), a string "[s]", which indicates double waiting, is appended to a string displayed in the semQ field.

Normal Display	26(_task26)
Display when in WAIT-SUSPEND	26(_task26)[s]
Display when in WAIT-SUSPEND with time out	26(_task26)[tmo][s]

- Up to 8 characters can be displayed in the task name in the semQ field.If a task name exceeds 8 characters, the extra characters are omitted.

7.10.6.2 Display the Semaphore Status (When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

All the SEMs defined in the configuration are listed in the order of ID number. The function of each item is listed below. (When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

Item	Contents
ID	ID No. of semaphore
Sematr	Attribute of each semaphore
Semcnt	Semaphore count
Semaphore Queue	Task ID Nos. and task names in the semaphore queue

- The following are displayed in the Sematr area:

TA_TFIFO	Task wait queue is in FIFO order
TA_TPRI	Task wait queue is in task priority order

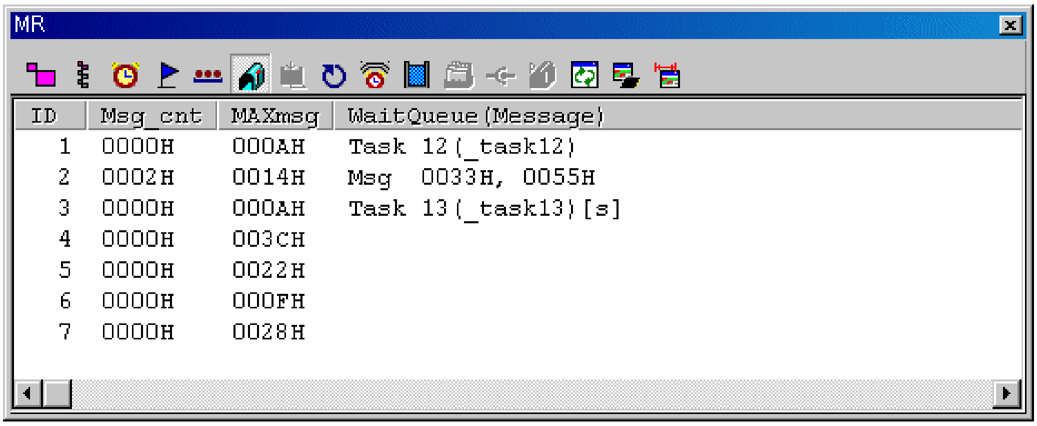
- When a task connected to the SEM queue is in the state of waiting with timeout enabled (waiting in twai_sem), a string "[tmo]", which indicates a state of waiting with timeout enabled, is appended to a string displayed in the Semaphore Queue field.
  When a task connected to the SEM queue is in the state of forced waiting (double waiting), a string "[s]", which indicates double waiting, is appended to a string displayed in the Semaphore Queue field.

Normal Display	26(_task26)
Display when in WAIT-SUSPEND	26(_task26)[s]
Display when in WAIT-SUSPEND with time out	26(_task26)[tmo][s]

- Up to 8 characters can be displayed in the task name in the Semaphore Queue field.If a task name exceeds 8 characters, the extra characters are omitted.

7.10.7 Display the Mailbox Status

In the MR window, select Popup Menu - [Mode] -> [Mailbox].



ID	Msg_cnt	MAXmsg	WaitQueue(Message)
1	0000H	000AH	Task 12(_task12)
2	0002H	0014H	Msg 0033H, 0055H
3	0000H	000AH	Task 13(_task13)[s]
4	0000H	003CH	
5	0000H	0022H	
6	0000H	000FH	
7	0000H	0028H	

7.10.7.1 Display the Mailbox Status (When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

All the mail boxes defined in the configuration are listed in the order of ID number. The function of each item is listed below. (When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

Item	Contents
ID	ID No. of mailbox
Msg_cnt	Number of messages in each mailbox
MAXmsg	Maximum number of messages that can be contained in each mailbox
Wait Queue(Message)	The messages stored in the mailbox or ID No. and task name of tasks waiting for messages

- The WaitQueue (Message) field shows a string "Msg" when a message is stored (when Msg_cont as described above is non-zero), and then displays the stored message.
  When no message is stored (when Msg_cont is zero), the WaitQueue field displays a string "Task" if a task waiting for a message exists, and then displays the ID number and name of the task waiting for a message.
- When a task connected to the mail box queue is in the state of waiting with timeout enabled (waiting in trcv_msg), a string "[tmo]", which indicates the state of timeout enabled, is appended to a string displayed in the WaitQueue (Message) field.
  When a task connected to the mail box queue is in the state of forced waiting (Double waiting), a string "[s]", which indicates the state of double waiting, is appended to a string displayed in the WaitQueue (Message) field.

Normal Display	26(_task26)
Display when in WAIT-SUSPEND	26(_task26)[s]
Display when in WAIT-SUSPEND with time out	26(_task26)[tmo][s]

- Up to 8 characters can be displayed in the task name in the WaitQueue (Message) field.
  If a task name exceeds 8 characters, the extra characters are omitted.

7.10.7.2 Display the Mailbox Status (When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

All the mail boxes defined in the configuration are listed in the order of ID number. The function of each item is listed below. (When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

Item	Contents
ID	ID No. of mailbox
Mbxatr	Attribute of each mailbox
Mailbox Queue (Wait)	ID No. and task name of tasks waiting for messages
Mailbox Queue (Message)	The messages stored in the mailbox

- The following are displayed in the Mbxatr area:

TA_TFIFO	Task wait queue is in FIFO order
TA_TPRI	Task wait queue is in task priority order
TA_MFIFO	Message queue is in FIFO order
TA_MPRI	Message queue is in message priority order

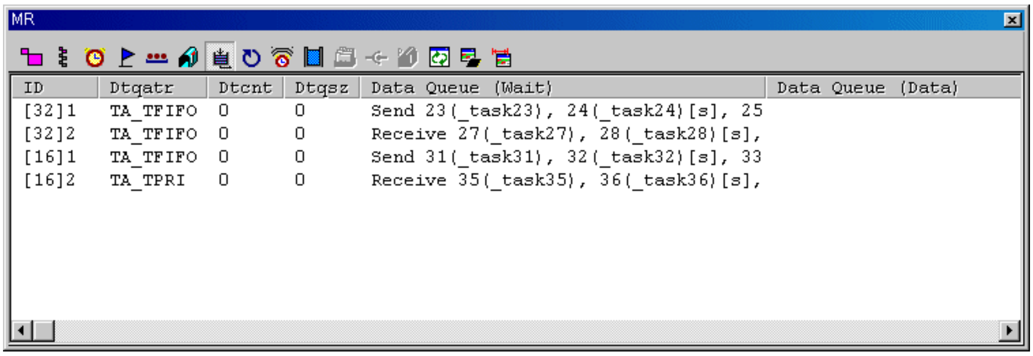
- When a task connected to the mail box queue is in the state of waiting with timeout enabled (waiting in trcv_mbx), a string "[tmo]", which indicates the state of timeout enabled, is appended to a string displayed in the Mailbox Queue (Wait) field.
  When a task connected to the mail box queue is in the state of forced waiting (Double waiting), a string "[s]", which indicates the state of double waiting, is appended to a string displayed in the Mailbox Queue (Wait) field.

Normal Display	26(_task26)
Display when in WAIT-SUSPEND	26(_task26)[s]
Display when in WAIT-SUSPEND with time out	26(_task26)[tmo][s]

- Up to 8 characters can be displayed in the task name in the Mailbox Queue (Wait) field. If a task name exceeds 8 characters, the extra characters are omitted.

7.10.8 Display the Data Queue Status

In the MR window, select Popup Menu - [Mode] -> [Data Queue].



ID	Dtqatr	Dtcnt	Dtqsz	Data Queue (Wait)	Data Queue (Data)
[32]1	TA_TFIFO	0	0	Send 23(_task23), 24(_task24)[s], 25	
[32]2	TA_TFIFO	0	0	Receive 27(_task27), 28(_task28)[s],	
[16]1	TA_TFIFO	0	0	Send 31(_task31), 32(_task32)[s], 33	
[16]2	TA_TPRI	0	0	Receive 35(_task35), 36(_task36)[s],	

7.10.8.1 Display the Data Queue Status(When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

All the data queues defined in the configuration are listed in the order of ID number. The function of each item is listed below. (When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

Item	Contents
ID	ID No. of data queue
Dtqatr	Attribute of each date queue
Dtcnt	Number of messages in each data queue
Dtqsz	Maximum number of messages that can be contained in each data queue
Data Queue (Wait)	ID No. and task name of tasks waiting for message transmission waiting or message reception waiting
Data Queue (Data)	The messages stored in the data queue

- The display of the ID field varies depending on which one is specified, the standard data(32 bits) or the extended data(16 bits).

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- If the standard data(32 bits), the ID field displays a string "[32]" and data queue ID number.
- If the extended data(16 bits), the ID field displays a string "[16]" and data queue ID number.

- The following are displayed in the Dtqatr area:

TA_TFIFO	Task wait queue is in FIFO order
TA_TPRI	Task wait queue is in task priority order

- The Data Queue (Wait) field displays a string "Send" if a task waiting for a message sending, and then displays the ID number and name of the task waiting for a message sending. Also, if a task waiting for a message receiving, displays a string "Receive" and then displays the ID number and name of the task waiting for a message receiving.
- When a task connected to the date queue is in the state of waiting with timeout enabled , a string "[tmo]", which indicates the state of timeout enabled, is appended to a string displayed in the Data Queue (Wait) field.

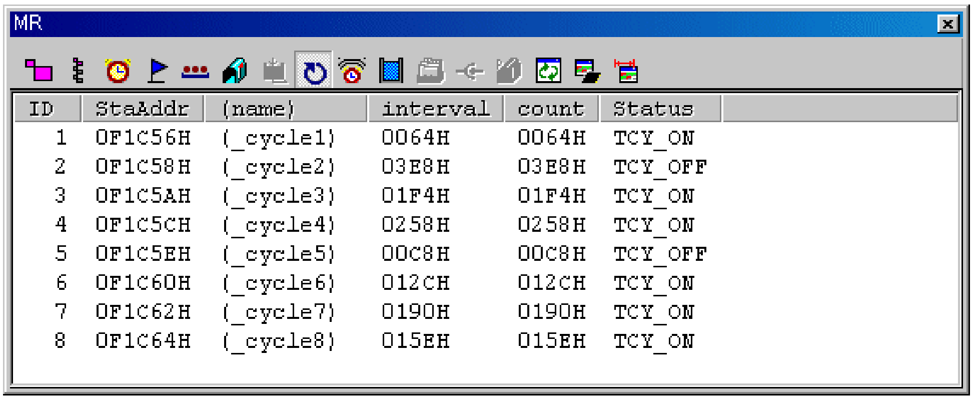
  When a task connected to the data queue is in the state of forced waiting (Double waiting), a string "[s]", which indicates the state of double waiting, is appended to a string displayed in the Data Queue (Wait) field.

Normal Display	26(_task26)
Display when in WAIT-SUSPEND	26(_task26)[s]
Display when in WAIT-SUSPEND with time out	26(_task26)[tmo][s]

- Up to 8 characters can be displayed in the task name in the Data Queue (Wait) field. If a task name exceeds 8 characters, the extra characters are omitted.

7.10.9 Display the Cycle Handler Status

In the MR window, select Popup Menu - [Mode] -> [Cyclic Handler].



```
 ID  StaAddr   (name)      interval  count   Status
  1  0F1C56H  (_cycle1)    0064H     0064H   TCY_ON
  2  0F1C58H  (_cycle2)    03E8H     03E8H   TCY_OFF
  3  0F1C5AH  (_cycle3)    01F4H     01F4H   TCY_ON
  4  0F1C5CH  (_cycle4)    0258H     0258H   TCY_ON
  5  0F1C5EH  (_cycle5)    00C8H     00C8H   TCY_OFF
  6  0F1C60H  (_cycle6)    012CH     012CH   TCY_ON
  7  0F1C62H  (_cycle7)    0190H     0190H   TCY_ON
  8  0F1C64H  (_cycle8)    015EH     015EH   TCY_ON
```

7.10.9.1 Display the Cycle Handler Status(When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

All the cycle handlers defined in the configuration are listed in the order of ID number. The function of each item is listed below. (When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

Item	Contents
ID	ID No. of cycle handler
StaAddr	Starting address of cycle handler
(name)	Name of cycle handler
interval	Interrupt interval
count	Interrupt count
Status	Activity status of cycle start handler

- The following are displayed in the Status area:

TCY_ON	Cycle handler enabled
TCY_OFF	Cycle handler disabled

7.10.9.2 Display the Cycle Handler Status(When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

All the cycle handlers defined in the configuration are listed in the order of ID number. The function of each item is listed below. (When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

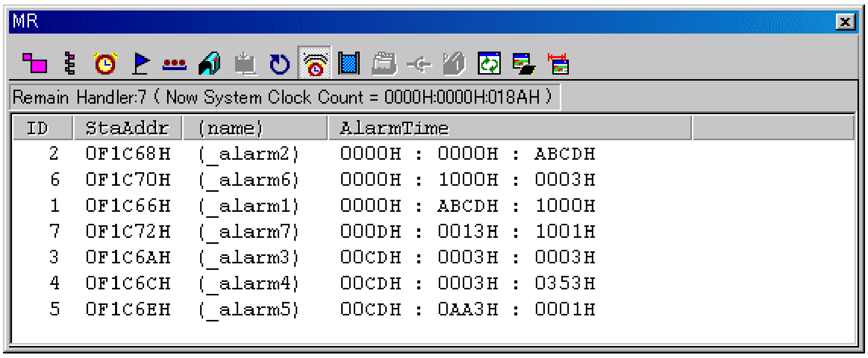
Item	Contents
ID	ID No. of cycle handler
Name	Name of cycle handler
Cycphs	The activation phase (by the millisecond)
Cyctim	The activation cycle time (by the millisecond)
Tmout	The amount of time by the millisecond remaining before the cyclic handler's next activation time
Status	Activity status of cycle start handler

- The following are displayed in the Status area:

TCYC_STA	Cycle handler is in an operational state
TCYC_STP	Cycle handler is in a non-operational state

7.10.10 Display the Alarm Handler Status

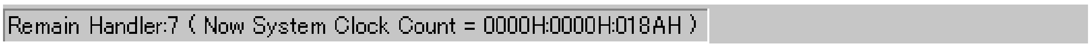
In the MR window, select Popup Menu - [Mode] -> [Alarm Handler].



Remain Handler:7 (Now System Clock Count = 0000H:0000H:018AH)

ID	StaAddr	(name)	AlarmTime
2	0F1C68H	(_alarm2)	0000H : 0000H : ABCDH
6	0F1C70H	(_alarm6)	0000H : 1000H : 0003H
1	0F1C66H	(_alarm1)	0000H : ABCDH : 1000H
7	0F1C72H	(_alarm7)	000DH : 0013H : 1001H
3	0F1C6AH	(_alarm3)	00CDH : 0003H : 0003H
4	0F1C6CH	(_alarm4)	00CDH : 0003H : 0353H
5	0F1C6EH	(_alarm5)	00CDH : 0AA3H : 0001H

When the realtime OS is MRxx conformed to uITRON specifications V.3.0, the following data is displayed in the status bar.



Remain Handler:7 (Now System Clock Count = 0000H:0000H:018AH)

7.10.10.1 Display the Alarm Handler Status(When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

Of all the cycle start handlers defined in the configuration, only those which are not started yet at present are listed in the ascending order of start time. The function of each item is listed below. (When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

Item	Contents
ID	ID No. of alarm handler
StaAddr	Starting address of alarm handler
(name)	Name of alarm handler
AlarmTime	Starting time of alarm handler

7.10.10.2 Display the Alarm Handler Status(When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

Of all the cycle start handlers defined in the configuration, only those which are not started yet at present are listed in the ascending order of start time. The function of each item is listed below. (When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

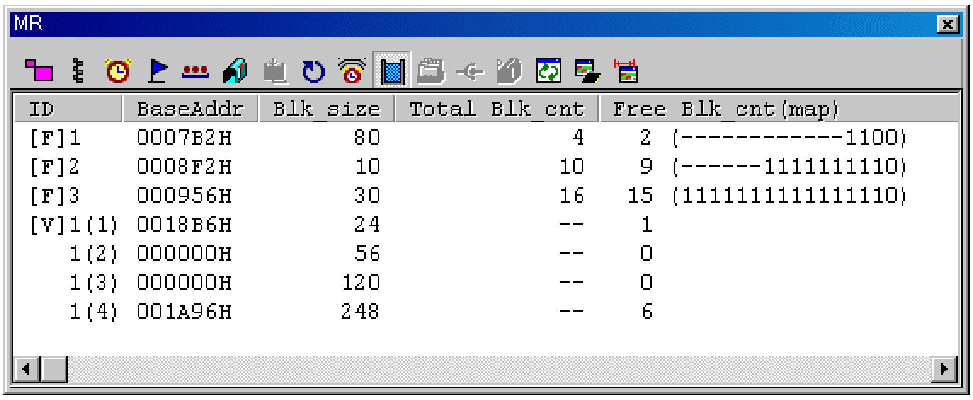
Item	Contents
ID	ID No. of alarm handler
Name	Name of alarm handler
Almtim	The amount of time by the millisecond remaining before the alarm handler's activation time
Status	Activity status of alarm handler

- The following are displayed in the Status area:

TALM_STA	Alarm handler is in an operational state
TALM_STP	Alarm handler is in a non-operational state

7.10.11 Display the Memory Pool Status

In the MR window, select Popup Menu - [Mode] -> [Memory Pool].



```
ID       BaseAddr  Blk_size  Total Blk_cnt  Free Blk_cnt(map)
[F]1     0007B2H         80              4   2 (------------1100)
[F]2     0008F2H         10             10   9 (------1111111110)
[F]3     000956H         30             16  15 (1111111111111110)
[V]1(1)  0018B6H         24             --   1
   1(2)  000000H         56             --   0
   1(3)  000000H        120             --   0
   1(4)  001A96H        248             --   6
```

7.10.11.1 Display the Memory Pool Status(When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

All the memory pools defined in the configuration are listed in the order of ID number. (The fixed length data comes first, and the optional length data comes after the fixed length data.) The function of each item is listed below. (When the realtime OS is MRxx conformed to uITRON specifications V.3.0.)

Item	Contents
ID	ID No. of memory pool
BaseAddr	Base address of memory pool
Blk_Size	Block size of memory pool
Total Blk_cnt	Tot a l block count of memory pool
Free Blk_cnt(map)	Number of unused blocks and information on unused memory blocks (bit information)

- The display of the ID field varies depending on which one is specified, fixed length or optional length.

- If the data is of fixed length, the ID field displays a string "[F]" and memory pool ID number.
- For an arbitrary length, the contents displayed on the first line are the character string "[V]," a memory pool ID number, and a block ID number. Displayed on the second to fourth lines are the memory pool ID and block ID numbers. The block ID numbers are enclosed in parentheses.

- When specifying the optional length memory pool, "--" is displayed in the Total Mlk_cut field.
  No bit information is displayed in the Free Blk_cnt (map) field.

- When specifying the fixed-length memory pool, the display format of each bit in the memory block information in Free Blk_cnt (map) is as shown below:

item	Contents
'0'	Memory block in use (busy)
'1'	Memory block not in use (ready)
'-'	No memory block

7.10.11.2 Display the Memory Pool Status(When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

All the memory pools are listed in the order of ID number. The function of each item is listed below. (When the realtime OS is MRxx conformed to uITRON specifications V.4.0.)

Item	Contents
ID	ID No. of memory pool
Mplatr	Attribute of each memory pool
Mpladr	Base address of memory pool
Mplsz	Size of memory pool
Blkcnt	Total block count of fixed length memory pool
Fblkcnt	Number of unused blocks and information on unused memory blocks
Memory Pool Queue	Displays the ID number and name of tasks waiting in the memory pool.

- The following are displayed in the Mplatr area:

TA_TFIFO	Task wait queue is in FIFO order
TA_TPRI	Task wait queue is in task priority order

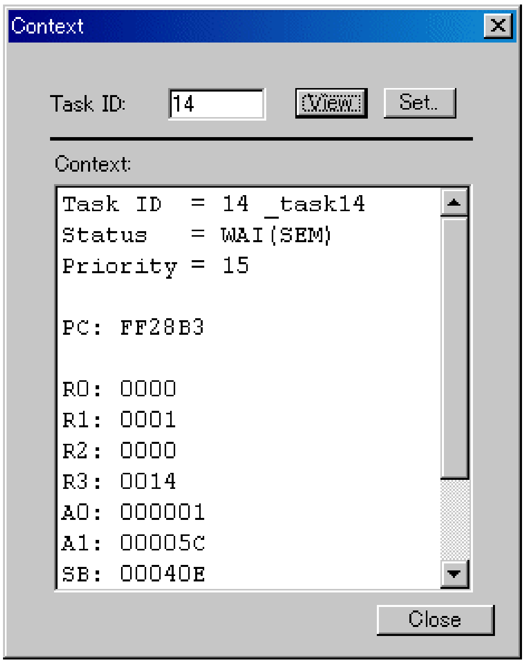
- The display of the ID field varies depending on which one is specified, fixed length or optional length.

- If the data is of fixed length, the ID field displays a string "[F]" and memory pool ID number.
- For an arbitrary length, the contents displayed on the first line are the character string "[V]," a memory pool ID number, and a block ID number. Displayed on the second to fourth lines are the memory pool ID and block ID numbers. The block ID numbers are enclosed in parentheses.

7.10.12 Display the Task Context

7.10.12.1 Display the Task Context

In the MR window, select Popup Menu - [Context...].
The Context dialog box is opened. The Context dialog box is used to reference/specify the context information of the specified task.
You can also open the Context dialog box by double-clicking the data display area in the task state display mode .



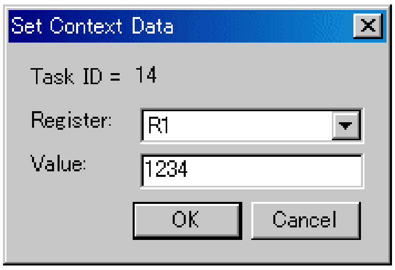
```
Task ID  = 14 _task14
Status   = WAI(SEM)
Priority = 15

PC: FF28B3

R0: 0000
R1: 0001
R2: 0000
R3: 0014
A0: 000001
A1: 00005C
SB: 00040E
```

Enter the task ID number in the Task ID field and click the View button (or press the Enter key).
The context of the specified task appears in the Context field.

- If the task entered in the Task ID field is "RUN" or "DMT" when clicking the View button, the context is not displayed. (In the Context field, only the task ID and task state are displayed.)
- If a task ID number which does not exist is entered in the Task ID field when clicking the View button, an error occurs.

7.10.12.2 Change the task context

Enter the task ID number in the Task ID field in the Context dialog and click the Set button. The Set Context dialog is opened.
The Set Context dialog is used to set the specified context register value of the specified task.


Set Context Data

Task ID = 14

Register: R1

Value: 1234

Specify the register to be changed in the Register field list box and enter the value to be set in the "Value:" field.
If an expression description set in the "Value:" field is wrong, or if the specified value is outside the allowable range set for the specified register, an error occurs.

8. Table of Script Commands

The following script commands are prepared.
The commands with yellow color displaying can be executed at run time.
The command to which "*" adheres behind is not supported according to the product.

8.1 Table of Script Commands (classified by function)

8.1.1 Execution Commands

Command Name	Short Name	Contents
Go	G	Program execution with breakpoints
GoFree	GF	Free run program execution
GoProgramBreak*	GPB	Run target program with software break point
GoBreakAt*	GBA	Run target program with software break point
Stop	-	Stops program execution
Status	-	Checks the operating status of the MCU
Step	S	Halts for user input until the specified time has elapsed
StepInstruction	SI	Step execution of instructions
OverStep	O	Overstep execution of source lines
OverStepInstruaction	OI	Overstep execution of instructions
Return	RET	Executes a source line return
ReturnInstruction	RETI	Executes an instruction return
Reset	-	Resets the target MCU
Time	-	Sets the run time display and checks the current setting

8.1.2 File Operation Commands

Command Name	Short Name	Contents
Load	L	Downloads the target program
LoadHex	LH	Downloads an Intel HEX-format file
LoadMot*	LM	Downloads a Motorola S-format file
LoadSymbol	LS	Loads source line/ASM symbol information
Reload	-	Re-downloads the target program
UploadHex	UH	Outputs data to an Intel HEX-format file
UploadMot*	UM	Outputs data to a Motorola S-format file

8.1.3 Register Operation Commands

Command Name	Short Name	Contents
Register	R	Checks and sets a register value

8.1.4 Memory Operation Commands

Command Name	Short Name	Contents
DumpByte	DB	Displays the contents of memory (in 1-byte units)
DumpWord*	DW	Displays the contents of memory (in 2-byte units)
DumpLword*	DL	Displays the contents of memory (in 4-byte units)
SetMemoryByte	MB	Checks and changes memory contents (in 1-byte units)
SetMemoryWord*	MW	Checks and changes memory contents (in 2-byte units)
SetMemoryLword*	ML	Checks and changes memory contents (in 4-byte units)
FillByte	FB	Fills a memory block with the specified data (in 1-byte units)
FillWord*	FW	Fills a memory block with the specified data (in 2-byte units)
FillLword*	FL	Fills a memory block with the specified data (in 4-byte units)
Move	-	Moves memory blocks
MoveLord*	MOVEL	Moves memory blocks(in 4-byte units)
MoveWord*	MOVEW	Moves memory blocks(in 2-byte units)

8.1.5 Assemble/Disassemble Commands

Command Name	Short Name	Contents
Assemble	A	Line-by-line assembly
DisAssemble	DA	Disassembles memory contents line by line
Module	MOD	Displays modules names
Scope	-	Sets and checks the effective local symbol scope
Section	SEC	Checks section information
Bit*	-	Checks and sets bit symbols
Symbol	SYM	Checks assembler symbols
Label	-	Checks assembler labels
Express	EXP	Displays an assembler expression

8.1.6 Software Break Setting Commands

Command Name	Short Name	Contents
SoftwareBreak	SB	Sets and checks software breaks
SoftwareBreakClear	SBC	Clears software breaks
SoftwareBreakClearAll	SBCA	Clears all software breaks
SoftwareBreakDisable	SBD	Disables software breakpoints
SoftwareBreakDisableAll	SBDA	Disables all software breaks
SoftwareBreakEnable	SBE	Enables software breakpoints
SoftwareBreakEnableAll	SBEA	Enables all software breaks
BreakAt	-	Sets a software breakpoint by specifying a line No.
BreakIn	-	Sets a software breakpoint by specifying a function

8.1.7 Real-time Trace Commands

Command Name	Short Name	Contents
TraceData*	TD	Realtime trace data display
TraceList*	TL	Displays disassembled realtime trace data

8.1.8 Event Setting Commands

Command Name	Short Name	Contents
EVent	EV	Sets and checks events

8.1.9 Script/Log File Commands

Command Name	Short Name	Contents
Script	-	Opens and executes a script file
Exit	-	Exits the script file
Wait	-	Waits for an event to occur before command input
Pause	-	Waits for user input
Sleep	-	Halts for user input until the specified time has elapsed
Logon	-	Outputs the screen display to a log file
Logoff	-	Stops the output of the screen display to a log file
Exec	-	Executes external application

8.1.10 Program Display Commands

Command Name	Short Name	Contents
Func	-	Checks function names and displays the contents of functions
Up*	-	Displays the calling function
Down*	-	Displays a called function
Where*	-	Displays a function call status
Path	-	Sets and checks the search path
AddPath	-	Adds the search path
File	-	Checks a filename and displays the contents of that file

8.1.11 Clock Command

Command Name	Short Name	Contents
Clock	CLK	Checks the clock

8.1.12 C Language Debugging Commands

Command Name	Short Name	Contents
Print	-	Check value of specified C variable expression
Set	-	Set specified data in specified C variable expression

8.1.13 Real-time OS Command

Command Name	Short Name	Contents
MR*	-	Displays status of realtime OS (MRxx)

8.1.14 Utility Commands

Command Name	Short Name	Contents
Radix	-	Sets and checks the radix for numerical input
Alias	-	Specifies and checks command alias definitions
UnAlias	-	Cancels the alias defined for a command
UnAliasAll	-	Cancels all aliases defined for commands
Version	VER	Displays the version No.
Date	-	Displays the date
Echo	-	Displays messages
CD	-	Window open

8.2 Table of Script Commands (alphabetical order)

Command Name	Short Name	Contents
AddPath	-	Adds the search path
Alias	-	Specifies and checks command alias definitions
Assemble	A	Line-by-line assembly
Bit*	-	Checks and sets bit symbols
BreakAt	-	Sets a software breakpoint by specifying a line No.
BreakIn	-	Sets a software breakpoint by specifying a function
CD	-	Specifies and checks the current directory
Clock	CLK	Checks the clock
Coverage	CV	Specifies and displays coverage measurement
Date	-	Displays the date
DisAssemble	DA	Disassembles memory contents line by line
Down*	-	Displays a called function
DumpByte	DB	Displays the contents of memory (in 1-byte units)
DumpLword*	DL	Displays the contents of memory (in 4-byte units)
DumpWord*	DW	Displays the contents of memory (in 2-byte units)
Echo	-	Displays messages
EVent	EV	Sets and checks events
Exec	-	Executes external application
Exit	-	Exits the script file
Express	EXP	Displays an assembler expression
File	-	Checks a filename and displays the contents of that file
FillByte	FB	Fills a memory block with the specified data (in 1-byte units)
FillLword*	FL	Fills a memory block with the specified data (in 4-byte units)
FillWord*	FW	Fills a memory block with the specified data (in 2-byte units)
Func	-	Checks function names and displays the contents of functions
Go	G	Program execution with breakpoints
GoBreakAt*	GBA	Run target program with software break point
GoFree	GF	Free run program execution
GoProgramBreak*	GPB	Run target program with software break point
Label	-	Checks assembler labels
Load	L	Downloads the target program
LoadHex	LH	Downloads an Intel HEX-format file
LoadMot*	LM	Downloads a Motorola S-format file
LoadSymbol	LS	Loads source line/ASM symbol information
Logoff	-	Stops the output of the screen display to a log file
Logon	-	Outputs the screen display to a log file
Module	MOD	Displays modules names
Move	-	Moves memory blocks
MoveLord*	MOVEL	Moves memory blocks(in 4-byte units)
MoveWord*	MOVEW	Moves memory blocks(in 2-byte units)
MR*	-	Displays status of realtime OS (MRxx)
OverStep	O	Overstep execution of source lines
OverStepInstruaction	OI	Overstep execution of instructions
Path	-	Sets and checks the search path

Pause	-	Waits for user input
Print	-	Check value of specified C variable expression.
Radix	-	Sets and checks the radix for numerical input
Register	R	Checks and sets a register value
Reload	-	Re-downloads the target program
Reset	-	Resets the target MCU
Return	RET	Executes a source line return
ReturnInstruction	RETI	Executes an instruction return
Scope	-	Sets and checks the effective local symbol scope
Script	-	Opens and executes a script file
Section	SEC	Checks section information
Set	-	Set specified data in specified C variable expression
SetMemoryByte	MB	Checks and changes memory contents (in 1-byte units)
SetMemoryLword*	ML	Checks and changes memory contents (in 4-byte units)
SetMemoryWord*	MW	Checks and changes memory contents (in 2-byte units)
Sleep	-	Halts for user input until the specified time has elapsed
SoftwareBreak	SB	Sets and checks software breaks
SoftwareBreakClear	SBC	Clears software breaks
SoftwareBreakClearAll	SBCA	Clears software breaks
SoftwareBreakDisable	SBD	Disables software breakpoints
SoftwareBreakDisableAll	SBDA	Disables all software breaks
SoftwareBreakEnable	SBE	Enables software breakpoints
SoftwareBreakEnableAll	SBEA	Enables all software breaks
Status	-	Checks the operating status of the MCU
Step	S	Step execution of source line
StepInstruction	SI	Step execution of instructions
Stop	-	Stops program execution
Symbol	SYM	Checks assembler symbols
Time	-	Sets the run time display and checks the current setting
TraceData*	TD	Realtime trace data display
TraceList*	TL	Displays disassembled realtime trace data
UnAlias	-	Cancels the alias defined for a command
UnAliasAll	-	Cancels all aliases defined for commands
Up*	-	Displays the calling function
UploadHex	UH	Outputs data to an Intel HEX-format file
UploadMot*	UM	Outputs data to a Motorola S-format file
Version	VER	Displays the version No.
Wait	-	Waits for an event to occur before command input
Where*	-	Displays a function call status

9. Writing Script Files

This debugger allows you to run script files in a Script Window. The script file contains the controls necessary for automatically executing the script commands.

9.1 Structural Elements of a Script File

You can include the following in script files:

- Script commands
- Assign statements
- Conditional statements (if, else, endi)
  Program execution branches to the statement(s) to be executed according to the result of the conditional expression.
- Loop statements (while, endw)
  A block of one or more statements is repeatedly executed according to the expression.
- break statement
  Exits from the innermost loop.
- Comment statements
  You can include comments in a script file. The comment statements are ignored when the script commands are executed.

Specify only one statement on each line of the script file. You cannot specify more than one statement on a line, or write statements that span two or more lines.

Notes

- You cannot include comments on the same lines as script commands.
- You can nest script files up to five levels.
- You can nest if statements and while statements up to 32 levels.
- If statements must be paired with endi statements, and while statements with endw statements in each script file.
- Expressions included in script files are evaluated as unsigned types. Therefore, operation cannot be guaranteed if you use negative values for comparison in if or while statements.
- You can specify up to 4096 characters per line. An error occurs if a line exceeds this number of characters.
- When a script file containing illegal commands is automatically executed (when you select [Option] -> [Script]-> [Run] from the Script Window menu after opening a script file, or click the button in the Script Window), execution of the script file continues even after the error is detected, except when the script line itself cannot be read. If an error is detected and the script file continues to be executed, operation after detection of the error cannot be guaranteed. Reliability cannot therefore be placed on the results of execution after an error has been detected.

9.1.1 Script Command

You can use the same script commands that you enter in the Script Window. You can also call script files from within other script files (nesting up to 10 levels).

9.1.2 Assign Statement

Assign statement s define and initialize macro variables and assign values. The following shows the format to be used.

```
%macro-variable = expression
```

- You can use alphanumerics and the underscore (_) in macro variable names. However , you cannot use a numeric to start a macro variable name.
- You can specify any expression of which the value is an integer between 0h and FFFFFFFFh to be assigned in a macro variable. If you specify a negative number, it is processed as twos complement.
- You can use macro variables within the expression.
- Always precede macro variables with the "%" sign.

9.1.3 Conditional Statement

In a conditional statement, different statements are executed according to whether the condition is true or false. The following shows the format to be used.

```
if ( expression )
    statement 1
 else
    statement 2
 endi
```

- If the expression is t rue (other than 0), statement 1 is executed. If false, (0), statement 2 is executed.
- You can omit the else statement. If omitted and the expression is false, execution jumps to the line after the endi statement.
- if statements can be nested (up to 32 levels).

9.1.4 Loop Statement(while,endw) and Break Statement

In loop statements, execution of a group of statements is repeated while the expression is true. The following shows the format to be used.

```
        while ( expression )
            statement
         endw
```

- If the expression is t rue, the group of statements is repeated. If false, the loop is exited (and the statement following the endw statement is executed).
- You can nest while statements up to 32 levels.
- Use the break statement to forcibly exit a while loop. If while statements are nested, break exits from the inner most loop.

9.1.5 Comment statements

You can include comments in a script file. Use the following format.

```
        ;character string
```

- Write the statement after a semicolon (;). You can include only spaces and tabs in front of the semicolon
- Lines with comment statements are ignored when the script file is executed.

9.2 Writing Expressions

This debugger allows you to use expressions for specifying addresses, data, and number of passes, etc. The following shows example commands using expressions.

```
>DumpByte TABLE1
>DumpByte TABLE1+20
```

You can use the following elements in expressions:

- Constants
- Symbols and labels
- Macro variables
- Register variables
- Memory variables
- Line Nos.
- Character constants
- Operators

9.2.1 Constants

You can use binary, octal, decimal, or hexadecimals. The prefix or suffix symbol attached to the numerical value indicates which radix is used.
The debugger for M32C and M16C/R8C and 740

	Hexadecimal	Decimal	Octal	Binary *
Prefix	0x,0X	@	None	%
Suffix	h,H	None	o,O	b,B
Examples	0xAB24 AB24h	@1234	1234o	%10010 10010b

*You can only specify % when the predetermined radix is hexadecimal.
If you are inputting a radix that matches the predetermined radix, you can omit the symbol that indicates the radix (excluding binary).

- Use the RADIX command to set the predetermined value of a radix. However, in the cases shown below, the radix is fixed regardless of what you specify in a RADIX command.

Type	Radix
Address	Hex
Line No. No. of executions No. of passes	Dec

9.2.2 Symbols and labels

You can include symbols and labels defined in your target program, or symbols and labels defined using the Assemble command.

- You can include alphanumerics, the underscore (_), period (.), and question mark (?) in symbols and labels. However, do not start with a numeric.
- Symbols and labels can consist of up to 255 characters.
- Uppercase and lowercase letters are unique.

Product Name	Notes
The debugger for M32R, The debugger for R32C, The debugger for M32C, The debugger for M16C/R8C,	• You cannot include the assembler structured instructions, pseudo instructions, macro instructions, operation code, or reserved words (.SECTION, .BYTE, switch, if, etc.). • You cannot use strings that start with two periods (..) for symbols or labels.

9.2.2.1 Local label symbol and scope

This debugger supports both global label symbols, which can be referenced from the whole program area, and local label symbols, which can only be referenced within the file in which they are declared. The effective range of local label symbols is known as the scope, which is measured in units of object files. The scope is switched in this debugger in the following circumstances:

- When a command is entered
  The object file that includes the address indicated by the program counter becomes the current scope. When the SCOPE command is used to set the scope, the specified scope is the active scope.
- During command execution
  The current scope automatically switches depending on the program address being handled by the command.

9.2.2.2 Priority levels of labels and symbols

The conversion of values to labels or symbols, and vice versa, is subject to the following levels of priority:

- Conversion of address values

1. Local labels
2. Global labels
3. Local symbols
4. Global symbols
5. Local labels outside scope
6. Local symbols outside scope

- Conversion of data values

1. Local symbols
2. Global symbols
3. Local labels
4. Global labels
5. Local symbols outside scope
6. Local labels outside scope

- Conversion of bit values

1. Local bit symbols
2. Global bit symbols
3. Local bit symbols outside scope

9.2.3 Macro Variables

Macro variables are defined by assign statements in the script file. See Section "9.1.2 Assign Statement " in the Reference part for details. Precede variables with '%' for use as macro variables.

- You can specify alphanumerics and/or the underbar (_) in the variable name following the percent sign (%). However , do not star t the names with a numeric.
- You cannot use the names of registers as variable names.
- Uppercase and lowercase letters are differentiated in variable names.
- You can define a maximum of 32 macro variables. Once defined, a macro variable remains valid until you quit the debugger.

Macro variables are useful for specifying the number of iterations of the while statement.

9.2.4 Register variables

Register variables are used for using the values of registers in an expression. Precede the name of the register with '%' to use it as a register variable. Use the following format.

Product Name	Register name
The debugger for R32C	PC, USP, ISP, INTB, FLB, SVF, SVP, VCT, DMD0, DMD1, DMD2, DMD3, DCT0, DCT1, DCT2, DCT3, DCR0, DCR1, DCR2, DCR3, DSA0, DSA1, DSA2, DSA3, DSR0, DSR1, DSR2, DSR3, DDA0, DDA1, DDA2, DDA3, DDR0, DDR1, DDR2, DDR3, 0R0, 0R1, 0R2, 0R3, 0R4, 0R5, 0R6, 0R7, <- Bank 0 Register 0A0, 0A1, 0A2, 0A3, 0FB, 0SB <- Bank 0 Register 1R0, 1R1, 1R2, 1R3, 1R4, 1R5, 1R6, 1R7, <- Bank 1 Register 1A0, 1A1, 1A2, 1A3, 1FB, 1SB <- Bank 1 Register

Uppercase and lowercase letters are not unique in register names. You can specify either.

9.2.5 Memory variables

Use memory variables to use memory values in expressions. The format is as follows:
[Address].data-size

- You can specify expressions in addresses (you can also specify memory variables).
- The data size is specified as shown in the following table.

data Length	Debugger	Specification
1 Byte	All	B or b
2 Bytes	The debugger for M32R	H or h
	Other	W or w
4 bytes	The debugger for M32R	W or w
	The debugger for M32R, M16C/R8C	L or l

Example: Referencing the contents of memory at address 8000h in 2 bytes

```
[0x8000].W
```

- The default data size is word, if not specified.

9.2.6 Line Nos.

These are source file line Nos. The format for line Nos. is as follows:

```
#line_no
#line_no."source file name"
```

- Specify line Nos. in decimal.
- You can only specify line Nos. in which software breaks can be set. You cannot specify lines in which no assembler instructions have been generated, including comment lines and blank lines.
- If you omit the name of the source file, the line Nos. apply to the source file displayed in active Editor(Source) Window.
- Include the file attribute in the name of the source file.
- Do not include any spaces between the line No. and name of the source file.

9.2.7 Character constants

The specified character or character string is converted into ASCII code and processed as a constant.

- Enclose characters in single quote marks.
- Enclose character strings in double quote marks.
- The character string must consist of one or two characters (16 bits max.). If more than two characters are specified, the last two characters of the string are processed. For example, "ABCD" would be processed as "CD", or value 4344h.

9.2.8 Operators

The table below lists the operators that you can use in expressions.

- The priority of operators is indicated by the level, level 1 being the highest and level 8 the lowest. If two or more operators have the same level of priority, they are evaluated in order from the left of the expression.

Operator	Function	Priority level
( )	Brackets	level 1
+, -, ~	Monadic positive, monadic negative, monadic logical NOT	level 2
*, /	Dyadic multiply, dyadic divide	level 3
+, -	Dyadic add, dyadic subtract	level 4
>>,	Right shift, left shift	level 5
&	Dyadic logical AND	level 6
|, ^	Dyadic logical OR, dyadic exclusive OR	level 7
<, <=, >, >=, ==, !=	Dyadic comparison	level 8

10. C/C++ Expressions

10.1 Writing C/C++ Expressions

You can use C/C++ expressions consisting of the tokens shown below for registering C watchpoints and for specifying the values to be assigned to C watchpoints.

Token	Example
Immediate values	10, 0x0a, 012, 1.12, 1.0E+3
Scope	::name, classname::member
Mathematical operators	+, -, *, /
Pointers	*, **, ...
Reference	&
Sign inversion	-
Member reference using dot operator	Object.Member
Member reference using arrow	Pointer->Member, this->Member
Pointers to Members	Object.*var, Pointer->*var
Parentheses	(,)
Arrays	Array[2], DArray[2] [3] , ...
Casting to basic types	(int), (char*), (unsigned long *), ...
Casting to typedef types	(DWORD), (ENUM), ...
Variable names and function names	var, i, j, func, ...
Character constants	'A', 'b', ...
Character string literals	"abcdef", "I am a boy.", ...

10.1.1 Immediate Values

You can use hexadecimals, decimals, octals as immediate values. Values starting with 0x are processed as hexadecimals, those with 0 as octals, and those without either prefix as decimals.
Floating-point numbers can also be used to assign values to variables.

Notes

- You cannot register only immediate values as C watchpoints.
- The immediate value is effective only when it is used in C/C++ language expressions that specify C/C++ watchpoints or when it is used to specify the value to be assigned to those expressions. When using floating-point numbers, operation cannot be performed on an expression like 1.0+2.0.

10.1.2 Scope Resolution

The scope resolution operator :: is available as following.
Global scope: ::valiable name

```
::x, ::val
```

Class scope: class name::member name, class name::class name::member name, e.g.

```
T::member, A::B::member
```

10.1.3 Mathematical Operators

You can use the addition (+), subtraction (-), multiplication (*), and division (/) mathematical operators. The following shows the order of priority in which they are evaluated.

```
(*), (/), (+), (-)
```

Notes

- There is no support currently for mathematical operators for floating point numbers.

10.1.4 Pointers

Pointers are indicated by the asterisk (*). You can use pointer to pointers **, and pointer to pointer to pointers ***, etc.

```
Examples: "*variable_name", "**variable_name", etc.
```

Notes

- Immediate values cannot be processed as pointers. That is, you cannot specify *0xE000, for example.

10.1.5 Reference

References are indicated by the ampersand (&). You can only specify "&variable_name".

10.1.6 Sign Inversion

Sign inversion is indicated by the minus sign (-). You can only specify "-immediate_value" or "-variable_name". No sign inversion is performed if you specify 2 (or any even number of) minus signs.

Notes

- There is no support currently for sign inversion of floating point numbers.

10.1.7 Member Reference Using Dot Operator

You can only use "variable_name.member_name" for checking the members of structures and unions using the dot operator.

Example:

```
class T {
public:
int member1;
char member2;
};
class T t_cls;
class T *pt_cls = &t_cls;
```

In this case, t_cls.member1, (*pt_cls).member2 correctly checks the members.

10.1.8 Member Reference Using Arrow

You can only use "variable_name->member_name" for checking the members of structures and unions using the arrow.

Example:

```
class T {
public:
int member1;
char member2;
};
class T t_cls;
class T *pt_cls = &t_cls;
```

In this case, (&t_cls)->member1, pt_cls->member2 correctly checks the members.

10.1.9 Pointers to Members

Pointers to members using the ".*" or "->*" operator can be refered only in the forms of variable name .* member name or variable name ->* member name.

Example:

```
class T {
public:
int member;
};
class T t_cls;
class T *pt_cls = &t_cls;

int T::*mp = &T::member;
```

In this case, t_cls.*mp and tp_cls->*mp can correctly reference the variable of pointer-to-member type.

Note

- Note that the expression *mp cannot considered as the variable of pointer-to-member type.

10.1.10 Parentheses

Use the '(' and ')' to specify priority of calculation within an expression.

10.1.11 Arrays

You can use the ' [' and '] ' to specify the elements of an array. You can code arrays as follows: "variable_name [(element_No or variable)] ", "variable_name [(element_No or variable)] [(element_No or variable)] ", etc.

10.1.12 Casting to Basic Types

You can cast to C basic types char, short, int, and long, and cast to the pointer types to these basic types. When casting to a pointer type, you can also use pointers to pointers and pointers to pointers to pointers, etc.

Note that if signed or unsigned is not specified, the default values are as follows:

Basic type	Default
char	unsigned
short	signed
int	signed
long	signed

Notes

- Of the basic types of C++, casts to bool type, wchar_t type, and floating-point type (float or double) cannot be used.
- Casts to register variables cannot be used.

10.1.13 Casting to typedef Types

You can use casting to typedef types (types other than the C basic types) and the pointer types to them. When casting to a pointer type, you can also use pointers to pointers and pointers to pointers to pointers, etc.

Notes

- You cannot cast to struct or union types or the pointers to those types.

10.1.14 Variable Name

Variable names that begin with English alphabets as required
under C/C++ conventions can be used.
The maximum number of characters for variable name is 255.
And 'this' pointer is available.

10.1.15 Function Name

Function names that begin with English alphabets as required
under C conventions can be used.
In the case of C++, no function names can be used.

10.1.16 Character Constants

You can use characters enclosed in single quote marks (') as character constants. For example, 'A', 'b' , etc. These character constants are converted to ASCII code and used as 1-byte immediate values.

Notes

- You cannot register character constants only as C watchpoints.
- Character constants are valid only when used in a C/C++ expression that specifies a C watchpoint, and when specifying a value to be assigned (character constants are processed in the same manner as immediate values).

10.1.17 Character String Literals

You can use character strings enclosed in double quote marks (") as character string literals. Examples are "abcde", "I am a boy.", etc.

Notes

- Character string literals can only be placed on the right side of an assignment operator in an expression. They can only be used when the left side of the assignment operator is a char array or a char pointer type. In all other cases, a syntax error results.

10.2 Display Format of C/C++ Expressions

C/C++ expressions in the data display areas of the C Watch Windows are displayed as their type name, C/C++ expression (variable name), and result of calculation (value), as shown below.
The following describes the display formats of the respective types.

10.2.1 Enumeration Types

- When the result (value) of calculation has been defined, its name is displayed.

```
(DATE) date = Sunday(all Radices)
```

- If the result (value) of calculation has not been defined, it is displayed as follows:

```
(DATE) date = 16 (when Radix is in initial state)
(DATE) date = 0x10(when Radix is hex)
(DATE) date = 0000000000010000B(when Radix is binary)
```

10.2.2 Basic Types

- When the result of calculation is a basic type other than a char type or floating point type, it is displayed as follows:

```
(unsigned int) i = 65280(when Radix is in initial state)
(unsigned int) i = 0xFF00(when Radix is hex)
(unsigned int) i = 1111111100000000B(when Radix is binary)
When the result of calculation is a char type, it is displayed as follows:
(unsigned char) c = 'J'(when Radix is in initial state)
(unsigned char) c = 0x4A(when Radix is hex)
(unsigned char) c = 10100100B(when Radix is binary)
```

- When the result of calculation is a floating point, it is displayed as follows:

```
(double) d = 8.207880399131839E-304(when Radix is in initial state)
(double) d = 0x10203045060708(when Radix is hex)
(double) d = 0000000010.....1000B(when Radix is binary)
(..... indicates abbreviation)
```

10.2.3 Pointer Types

- When the result of calculation is a pointer type to other than a char* type, it is displayed in hexadecimal as follows:

(unsigned int *) p = 0x1234(all Radices)

- When the result of calculation is a char* type, you can select the display format of the string or a character in the C Watch window's menu [Display String].

- string types

(unsigned char *) str = 0x1234 "Japan"(all Radices)

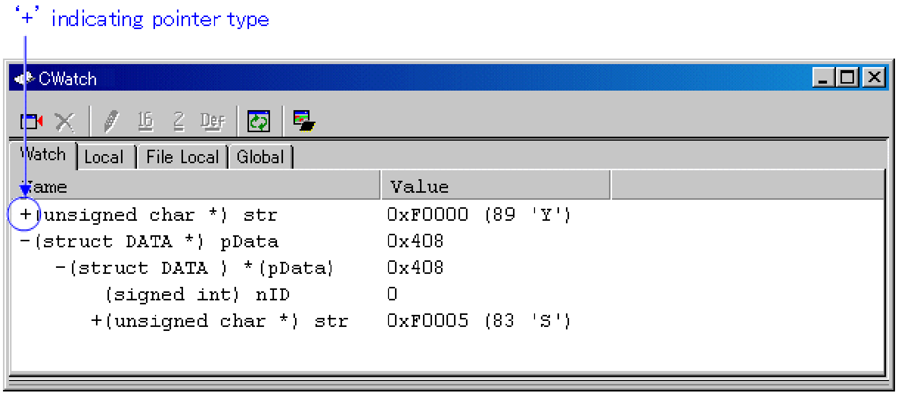
- character types

(unsigned char *) str = 0x1234 (74 'J')(all Radices)

l When the result of calculation is a char* type, it is displayed as follows:

(unsigned char *) str = 0x1234 "Jap(all Radices)

If the string contains a non-printing code prior to the code to show the end of the string (0), it is displayed up to the non-printing character and the closing quote mark is not displayed.



```
Name                                Value
+(unsigned char *) str              0xF0000 (89 'Y')
-(struct DATA *) pData              0x408
   -(struct DATA ) *(pData)         0x408
       (signed int) nID             0
      +(unsigned char *) str        0xF0005 (83 'S')
```

You can double-click on lines indicated by a '+' to see the members of that structure or union. The '+' changes to a '-' while the members are displayed. To return to the original display, double click the line, now indicated by the '-'.

10.2.4 Array Types

- When the result of calculation is an array type other than a char [ ] type, the starting address is displayed in hex as follows:

```
(signed int [10]) z = 0x1234(all Radices)
```

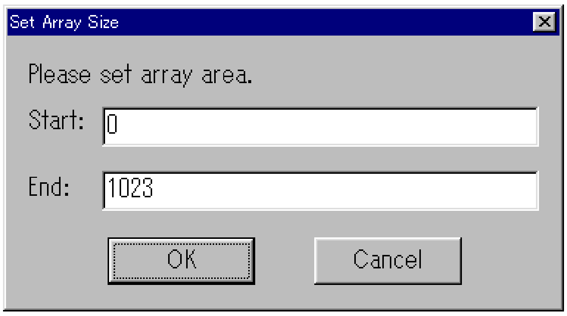
- When the result of calculation is a char [ ] type, it is displayed as follows:

```
(unsigned char [10]) str = 0x1234 "Japan"(all Radices)
```

If the string contains a non-printing code prior to the code to show the end of the string (0), it is displayed up to the non-printing character and the closing quote mark is not displayed.

```
(unsigned char [10]) str = 0x1234 "Jap(all Radices)
```

Also if the string contains more than 80 characters, the closing quote mark is not displayed. When the C/C++ expression is an array type as same as pointer type, a '+' is display to the left of the type name. You can see the elements of the array by using this indicating. (for the details, refer"10.2.3 Pointer Types") When the number of the array elements is more than 100, the following dialog box open. Specify the number of the elements in the dialog box.


Set Array Size

Please set array area.

Start: 0

End: 1023

The elements from the index specified in "Start" to the index specified in "End" are displayed. If you specify the value more than the max index of the array, the value is regarded as max index of the array. When you click the "Cancel" button, the elements are not displayed.

10.2.5 Function Types

- When the result of calculation is a function type, the starting address is displayed in hex as follows:

```
(void()) main = 0xF000(all Radices)
```

10.2.6 Reference Types

- When the result of calculation is a reference type, the reference address is displayed in hex as follows:

```
(signed int &) ref = 0xD038(all Radices)
```

10.2.7 Bit Field Types

- When the result of calculation is a bit field type, it is displayed as follows:

```
(unsigned int :13) s.f = 8191(when Radix is in initial state)
(unsigned int :13) s.f = 0x1FFF(when Radix is hex)
(unsigned int :13) s.f = 1111111111111B(when Radix is binary)
```

10.2.8 When No C Symbol is Found

If the calculated expression contained a C symbol that could not be found, it is displayed as follows:

```
() x = <not active>(all Radices)
```

10.2.9 Syntax Errors

- When the calculated expression contains a syntax error, it is displayed as follows:

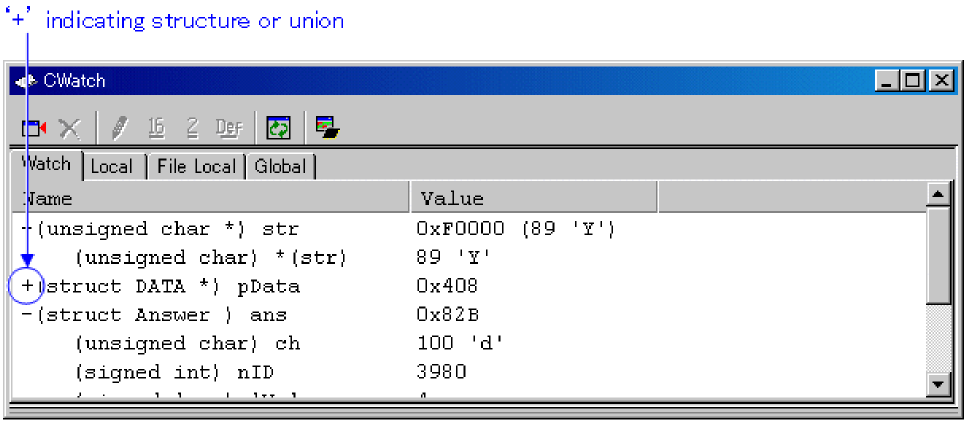
```
() str*(p = <syntax error>(all Radices)
(where str*(p is the syntax error)
```

10.2.10 Structure and Union Types

- When the result of calculation is a structure or union type, the address is displayed in hex as follows:

```
(Data) v = 0x1234  (all Radices)
```

If, as in structures and unions, the C/C++ expression consists of members, a '+' is displayed to the left of the type name (tag name).


'+' indicating structure or union

Name	Value
-(unsigned char *) str	0xF0000 (89 'Y')
(unsigned char) *(str)	89 'Y'
+(struct DATA *) pData	0x408
-(struct Answer) ans	0x82B
(unsigned char) ch	100 'd'
(signed int) nID	3980

You can double-click on lines indicated by a '+' to see the members of that structure or union. The '+' changes to a '-' while the members are displayed. To return to the original display, double click the line, now indicated by the '-'. This function allows you to check the members of structures and unions.

Attention

If a variable is declared with the same name as the type definition name declared by typedef, you cannot reference that variable.

- Register Variables

When the result of calculation is a register variable, "register" is displayed to the left of the type name as follows:

```
(register signed int) j = 100
```

11. Display the Cause of the Program Stoppage

If the program is stoped by the debug function, the cause of the stoppage is displayed in the Output window or Status window ([Platform] sheet).
The contents of a display and the meaning of "the cause of the stoppage" are as follows.

Display	The cause of the stoppage
Halt	The stop by the [Halt Program] button/menu
Program	Program break(software break) or Instruction Execution break(event break)
Event, Data Access	Memory Access break(event break)

12. Attention

12.1 Common Attention

12.1.1 File operation on Windows

1. File Name and Directory Name
   - Operation is not guaranteed if your directory names and filenames include kanji.
   - Use only one period in a filename.
2. Specify the File and Directory
   - You cannot use "..." to specify two levels upper directories.
   - You cannot use a network pathname. You must allocate a drive.

12.1.2 Area where software breakpoint can be set

The area where the software breakpoint can be set is different according to the product.

12.1.2.1 The debugger for R32C

Software breakpoints can be set in the MCU's internal RAM area, MCU's internal flash ROM area, and the RAM area in the user target.

ATTENTION

- If a breakpoint in the MCU's internal flash ROM area is specified, it is necessary that instructions be rewritten or written back in block units. Therefore, no software breakpoints can be set while the target program is running.
- If the area is an instruction non-rewritable area such as the ROM area in the user target, no software breakpoints can be set.

12.1.3 Get or set C variables

- If a variable is declared with the same name as the type definition name declared by typedef, you cannot reference that variable.
- Values cannot be changed for register variables.
- Values cannot be changed for 64 bit width variables (long long, double, and so on).
- Values cannot be changed for C/C++ expressions that do not indicate the memory address and size.
- For the sake of optimization, the C compiler may place different variables at the same address. In this case, values of the C variable may not be displayed correctly.
- Literal character strings can only be substituted for char array and char pointer type variables.
- No arithmetic operations can be performed on floating point types.
- No sign inversion can be performed on floating point types.
- Casting cannot be performed on floating point types.
- Casting cannot be performed on register variables.
- Casting cannot be performed on structure types, union types, or pointer types to structure or union types.
- Character constants and literal character strings cannot contain escape sequences.
- The following values can be substituted for the bit-fields.

- integer constants, character constants, and enumerators
- variables of bool types, characters types, integers types, and enumeration types
- bit-field

When the substituted value is larger than the size of the bit-field, it will be truncated.

- The bit-field member allocated in the SFR area might not be transformed into a correct value.
- While the target program is running, values of local variables and bit-fields cannot be modified.

12.1.4 Function name in C++

- When you input the address using the function name in setting display address, setting break points, and so on, you can not specify the member function, operator function, and overloaded function, of a class.
- You can not use function names for C/C++ expression
- No script commands (e.g., breakin and func) can be used in which function names are specified for arguments.
- In address value specifying columns of dialog boxes, no addresses can be specified using function names.
- The pointers for a member function can not be referred correctly in C watch window.

12.1.5 Option settings for download modules

These options, which can be set in "Debug Settings" dialog box, are invalid for this debugger:

- Offset : specified value is regarded as ‘0’
- Access size : specified value is regarded as ‘1’
- Perform memory verify during download : Not supported.

12.1.6 Debugging multi modules

If you register two or more absolute module file in one session, you can download only one file in same time.
If you register one absolute module file and one or more machine language file in one session, you can download all file in same time.

12.1.7 Synchronized debugging

Synchronized debugging function is not available.

12.1.8 Down-load of Firmware

The emulator must have the suitable firmware downloaded into it. The debugger inspects the version of the emulator's internal firmware as it starts up. If it is found that the emulator does not have the firmware files needed for it, the emulator enters a mode in which the firmware is forced to be downloaded at the debugger startup.

12.1.9 Check of ID Code

Checks the ID code written in the flash memory at the debugger startup. When the ID code is written in the flash memory, a dialog box to input the ID code appears. Enter the correct ID code in the dialog box. If the ID code you have supplied does not match, the debugger will not start.

12.1.10 The start procedure of debugger.

To start the debugger, follow one of the procedures described below.

- Turn on the power for the emulator and target -> Start the debugger -> Set up the Init dialog box -> Reset the target in hardware
- Turn on the power for the emulator -> Start the debugger -> Set up the Init dialog box -> Turn on the power for the target

If the target needs to be reset in hardware or the power for the target needs to be turned on, the dialog box to inform that thing appears. In that case, reset the target in hardware or turn on the power for the target and then click the OK button.

12.1.11 Use of Watch dog timer

You can debug a program making use of the watchdog timer. Only when the watchdog timer is active, the emulator's monitor program performs refreshing.

12.1.12 Debugging Resource on MCU

Since the MCU's internal break events share trace events and time measurement events, there is a total of 8 break events.

12.1.13 Setting of break point on MCU's internal RAM area

Please use the software breakpoint to the MCU's internal RAM area to use the hardware break resource effectively.

12.2 Attention of the R32C Debugger

12.2.1 Stack area used by the emulator

The emulator uses the interrupt stack area as its work area (MAX 52 bytes).
When debugging, allocate a sufficient interrupt stack area consisting of the regularly used size plus 52 bytes.

12.2.2 Interrupt stack pointer when resetting the target program

The emulator sets the interrupt stack pointer (ISP) to 0500h when resetting the target program.
Remember that the interrupt stack pointer (ISP) is set to 0000h on a unit at the production stage.

12.2.3 RAM area used by the data compare break function

Be aware that when you are using the data comparison break function based on event E5, 8 bytes from the beginning of the MCU's internal RAM (address 0400h) are used.

12.2.4 Option of C Compiler/Assembler/Linker

The information may not be downloaded/debugged normally depending on the option designation of the compiler, assembler, and linker.
Refer to "12.3 Option of C Compiler/Assembler/Linker"

The compiler that can be used by R32C debugger:

- NCxx
- the IAR EC++ Compiler
- the IAR C Compiler

12.3 Option of C Compiler/Assembler/Linker

We do not evaluate other settings, so we can not recommend to append other options.

12.3.1 When Using NCxx

When -O, -OR or -OS option is specified at compilation, the source line information may not be generated normally due to optimization, causing step execution to be operated abnormally.
To avoid this problem, specify -ONBSD (or -Ono_Break_source_debug) option together with -O, -OR or OS option.

12.3.2 When Using the IAR EC++ Compiler (EW)

Please specify the project setting by following process.

1. The Setting in the IAR Embedded Workbench
   When you select the menu [Project] -> [Options...], the dialog for "Options For Target " target"" will open. In this dialog, please select the "XLINK" as category, and set the project setting.
   - Output Tab
     In the "Format" area, check the "Other" option, and select the "elf/dwarf" as "Output Format".
   - Include Tab
     In the "XCL File Name" area, specify your XCL file (ex: lnkm32cf.xcl).
2. Edit the XCL file
   Add the command line option "-y" to your XCL file. The designation of "-y" option varies depending on the product.

Product Name	-y Option
The debugger for R32C	-yspc

3. Build your program after the setting above.

We do not evaluate other settings, so we can not recommend to append other options.

12.3.3 When Using the IAR C Compiler (EW)

Please specify the project setting by following process.

1. The Setting in the IAR Embedded Workbench
   When you select the menu [Project] -> [Options...], the dialog for "Options For Target " target"" will open. In this dialog, please select the "XLINK" as category, and set the project setting.
   - Output Tab
     In the "Format" area, check the "Other" option, and select the "ieee-695" as "Output Format".
   - Include Tab
     In the "XCL File Name" area, specify your XCL file (ex: lnkm16c.xcl).
2. Edit the XCL file
   Add the command line option "-y" to your XCL file. The designation of "-y" option varies depending on the product.

Product Name	-y Option
The debugger for R32C	-ylmb

3. Build your program after the setting above.

In the options other than the above-mentioned, the operation check is not done. Please acknowledge that the options other than the above-mentioned cannot be recommended.

12.3.4 When Using the IAR C Compiler (ICC)

12.3.4.1 Specify the Option

Please compile according to the following procedures and link.

- At compilation

Specify the "-r" option.

- Before linking

Open the linker's option definition file (extension .xcl) to be read when linking and add "-FIEEE695" and "-y" options. The designation of "-y" option varies depending on the product.

Product Name	-y Option
The debugger for R32C	-ylmb

- At link

Specify the linker's option definition file name using "-f" option.

In the options other than the above-mentioned, the operation check is not done. Please acknowledge that the options other than the above-mentioned cannot be recommended.

12.3.4.2 Command Execution Examples

The following shows examples of entering commands depending on the product

- The debugger for M32C

```
>ICCR32C -r file1.c<Enter>
>ICCR32C -r file2.c<Enter>
>XLINK -o filename.695 -f lnkr32c.xcl file1 file2<Enter>
```

The XCL file name varies depending on the product and memory model. For details, see the ICCxxxx manual.

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Publication Date:	July. 1, 2008	Rev.1.00
Published by:	Sales Strategic Planning Div. Renesas Technology Corp.	
Edited by:	Microcomputer Tool Development Department Renesas Solutions Corp.	

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